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Editorial

The team of your much appreciated e-journal "Heritage and Us: Conserve it for the Future" proudly announces completion of its one graceful year in the field of heritage and spreading awareness about our irreplaceable culture. Our team thanks all of you who from time-to-time provided us support and encouragement in making this publication successful.

We feel elated when we received research papers from renowned scholars, experts and active people from the fields of archaeology, history, conservation, heritage, culture and many more. Contributions from different field experts provided us an insight into current trends and issues worldwide. Our team puts best possible effort to present all those papers for our readers, though difficult but we present whatever we can deliver at its best.

As per the vision of the world we live in a dynamic environment and it also changes our personal values. It's the changing economy that brings changes in our lives and our surrounding as it is the base of our entire existence. Our cultural heritage is no exception to this dynamism.

Cultural heritage is part of our national identity and human entity as well. It acts as a fuel for our tourism industry promoting agencies that spend their lives to safeguard heritage. It plays a vital role in creating employment and further creating revenue at national level in the form of taxes, which afterwards gets invested for improving the living standard of the people and infrastructure. Thus the significance of Cultural Heritage as an economic process is undeniable. Hence it becomes necessary for us, citizens of country to conserve and promote the national cultural stock/antiquities by various available preservation, conservation and promotional techniques and policy initiatives.

Public takes government bodies for granted as liable for conservation of cultural heritage while nothing can be achieved without the contribution of the society as a whole. Today government surely plays the superior role in conservation but there is lack of investment in it. The matter was never taken so seriously up till now but according to world scenario it requires more attention and funds to fulfill the requirements.

Economic stability is the foremost problem of conservation and heritage promotion. Strategies need to be planned and implemented for sustainability. We believe that without such strategies and its success, we cannot retain our cultural heritage for longer period of time. If we feel heritage is for posterity then it becomes necessary for different field professionals to join hands and take full initiative in spreading this word of wisdom like our team is doing and serving for a year now.

Thanks to all our readers… your appreciation can make us reach new heights of success and contentment. Hope this relation continues for upcoming issues as well…

Gurpreet Singh





History and Archaeology



Appliqué Wares of Sidduwala:
Late Harappan Culture of Cholistan

Amna Tofique

Cholistan is a vast desert of Pakistan which came into existence with the walkout of monsoon for long time which consequently resulted in the desiccation of gigantic River Hakra. It lies in the territory of Bahawalpur, a former state of Pakistan. It is an extension of the Great Indian Desert which covers an area of 2.6 million hectare formed the southeast quadrant of Punjab province, placed between 27°42' and 29°45' North latitude and 69°52'and 73°05' East longitude (Vandal 2011: 10; Ahmad 2012: 165-172). Sands of Cholistan are saturated with archaeological assets of early, mature and late Harappan occupations of Indus valley.

Cholistan desert is marked by a lot of detailed explorations but unfortunately it didn't have any comprehensive excavation due to which archaeological resources embedded in stratigraphy of the desert have not been studied by archaeologists. Cholistan desert was initially explored by Sir Aurel Stein (1941) who recorded the archaeological mounds and sites located on the banks of Hakra River (Stein 1995: 57-98). Fifteen years after Sir Aurel Stein's survey, Henry Field (1955) visited Cholistan; his explorations include archaeological, cultural, floral and faunal documentations (Field 1959: 144-177). Dr Mughal, who made his appraisal in 1970s entirely for archaeological purpose, recorded almost three hundred and seventy sites which include Hakra phase, early Harappan phase, mature Harappan phase, late Harappan phase, plain grey ware culture and historic period. Recently in 2007 and 2011-12, Dr Farzand Masih surveyed Cholistan and recorded a large number of prehistoric sites. Five mounds of Sidduwala are located in Cholistan desert on the right bank of dried bed of Hakra River (SDW I: 71°13'40''E, 28° 57'43''N , SDW II: 71°14'02''E, 28°58'00''N, SDW III: 71°14'11''E, 28°58'13''N, SDW IV: 71° 14'01''E, 28°58'23''N, SDW V: 71°13'25''E, 28°58'18''N). It was initially explored by Sir Aurel Stein (1941) and then Dr Rafique Mughal reconnoitered six mounds of Sidduwala (1970s), finally Dr Farzand Masih re-explored the site and recorded five mounds which dominantly represent late Harappan culture. Whole area of Sidduwala is covered with thick stratum of material culture i.e. antiquities and pottery pieces which include painted, burnished and plain wares of early and mature Harappan period along with majority of the late Harappan deposits.

The most ubiquitous and prominent attribute of Sidduwala pottery is appliqué decoration which absolutely dominates whole pottery assemblages of red ware. The term 'appliqué' is defined as an ornamental device or technique that is applied as slice of a material on another surface of the same material for purpose of ornamentation. In the context of ceramics, appliqué is an isolated segment of clay, applied on the primary vessel in leather hard condition before baking, frequently for the purpose of embellishment. Archeologists

have been puzzled by the appliqué decorations found in the ceramic assemblage of the Indus valley civilisation. W.A. Fairservis (1956, 1959) describes it as appliqué ware while Dr Rafique Mughal (1997) describes it as wet ware. However in author's opinion the term appliqué is most appropriate for these wares.

Sidduwala is a single late Harappan site which exhibits a large quantity of appliqué wares. Pot sherds bearing appliqué collected from the surface comprises of 28% of whole assemblage. Diversity of appliqué designs, their presentation, demonstration in various ways i.e. regular and irregular, their finishing techniques are no doubt very mature and countless.

Famous forms of appliqué wares are pots and jars which bear appliqué below the shoulder. The vessels in this class are mostly medium-sized with thin and medium thick body and have a condensed feel on touching due to fine and well levigated clay used for manufacturing. Texture of material used for appliqué is very fine and compact with negligible amount of the sand as compared to primary vessel. Application of appliqué is done before firing when the vessel is in leather hard condition. Majority of the sherds exhibit remarkable appliqué decorations due to ideal environmental conditions of preservation and their inorganic nature. But in many cases appliqué layer often peels off in places in due to physical stress and long course of time. The interior of such pots have trimming and shoveling marks along with the marks of beating, dabbing and finger impressions. The author tries to classify the wares on the basis of several appliqué devices and describe individual device in order to identify different phases of its development and their relation to each other. It is done to assess whether pottery assemblage tells us much about the stylistic, aesthetic and technical sense of Sidduwala people. It further analyses the data of all major appliqué decorative wares one by one and attempts to provide certain developmental trends and characteristics of late Harappan pottery of Sidduwala. After deep observation of the appliqué wares, it can be perceived that potters of Sidduwala were very intellectual minded and made many experiments for developing new techniques and designs of appliqué. Primarily, appliqué wares can be classified into five major classes and one miscellaneous group based on application of mud in numerous styles with diverse techniques.

1. Wavy appliqué
2. Pointed appliqué
3. Floral appliqué
4. Diamond appliqué
5. Latticed appliqué
6. Miscellaneous appliqué

Style of one appliqué is different from another appliqué ware. Each class is subdivided into regular or irregular appliqué and their evolutionary pathways. Irregular appliqué means appliqué designs applied in both right and left directions or in any other distorting arrangement on a single sherd whereas regular appliqué limits designs in single direction exhibiting uniformity. For example, figure 1 (a to d) represents the upper regular and lower irregular wavy appliqué decorations prominently.

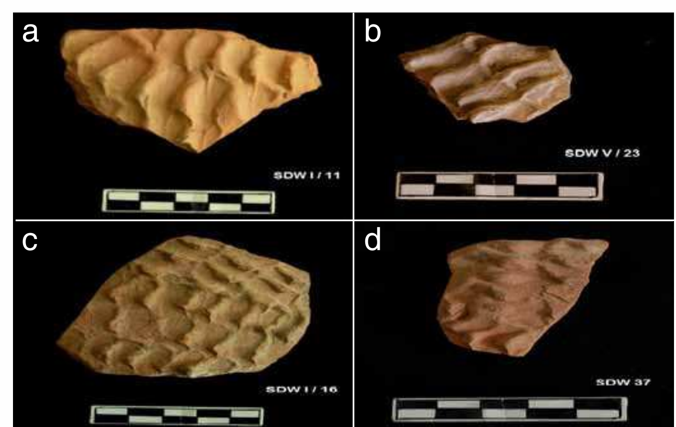


fig. 1 (a to d): Sidduwala/ Cholistan/ Bahawalpur/ Punjab: Upper regular and lower irregular wavy appliqué sherds (Source: Adeel Hashmi, Dept. of Archaeology, University of the Punjab, 2011-12)

Texture of Sidduwala appliqué ware is medium to fine. It has visible gritty core and lime in small amounts. Clay is well levigated as result of which wares formed are compact. Cracks, pits and fissures are very limited or absent. Firing of Sidduwala appliqué ware varies from medium to good. Most of the vessels are baked under ideal conditions, displays brick red color. Few wavy and latticed appliqué wares are medium fired with grey core and blackish surface. A single pointed appliqué ware is poorly fired with whole black cross section.

Wavy Appliqué Decoration

Most common form is wavy appliqué in which mud is turned to wavy appearance very carefully which looks very beautiful and stunning. This form appears to be primitive form of appliqué from which other decorative devices may have arisen. Similarly wavy appliqué represents both the evident regular or very orderly applied appliqué and irregular appliqué i.e. same pot is decorated with horizontal and vertical application of mud with rough hands (fig. 1 a to d as on page 7; fig. 2). Forms of appliquéd waves vary from small to large, which might be applied on single vessel or on separate vessels.



fig. 2. Sidduwala/ Cholistan/ Bahawalpur/ Punjab: Wavy appliqué design (Drawn by: Amna Tofique, 2013)

Application of wavy appliqué starts from shoulder of the vessel and continues to the base round or globular vessels which do not bear any ridge or carination that act as border between plain shoulder and appliquéd body.

Though wavy appliqué designs are highest in quantity in appliqué wares, they have least diversity of designs. In the figure 1 (a and b), two sherds SDW II / 11 and SDW V / 23 represent the regular appliqué encrusted with thin mud slurry resulted in their shiny and smooth surface and to some extent made them non porous while SDW I / 16 and SDW 37 in figure 1 (c and d) represent irregular appliqué with plain and defaced surface. So we can guess that potters paid more attention to the finishing of regular wavy appliqué wares than irregular appliqué wares, supposedly regular appliqué wares were used by royal society while irregular appliqué wares were used by common people.

Pointed Appliqué Decoration

Pointed appliqué appears broad at the base with small and sharp tip at peaks. These Pointeds might be regular or irregular. Regular pointed appliqué consists of Pointeds with same size, shape and equal distance with geometrical distribution, while irregular appliqué consist of defaced or displaced Pointeds with unequal

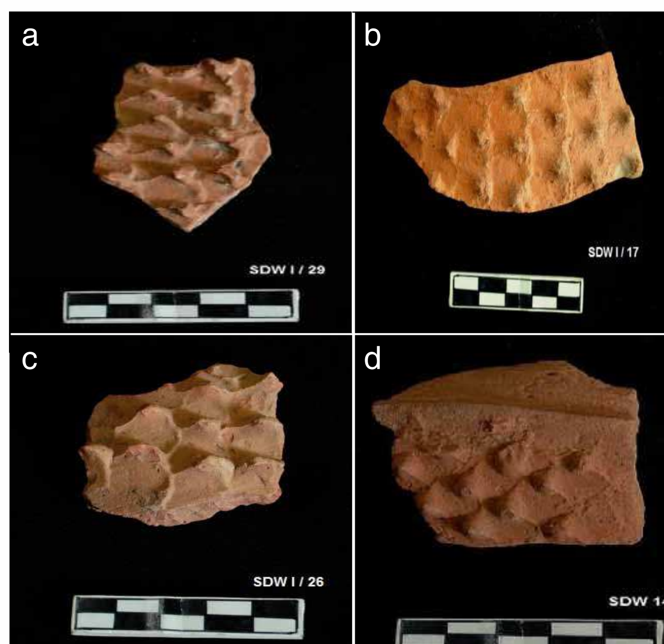


fig. 3 (a to d). Sidduwala/ Cholistan/ Bahawalpur/ Punjab: Upper Pointed Appliqué and lower Mature Pointed Appliqué Ware (Source: Adeel Hashmi, Dept. of Archaeology, University of the Punjab, 2011-12)

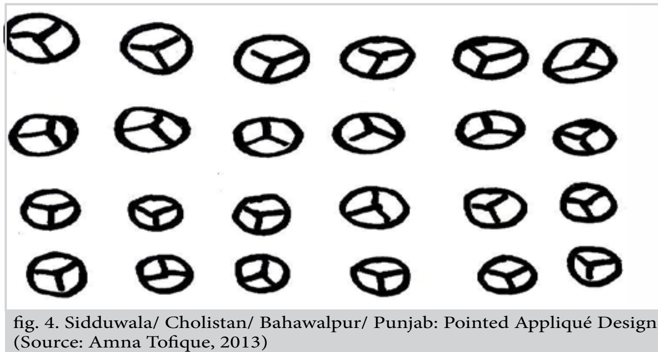


fig. 4. Sidduwala/ Cholistan/ Bahawalpur/ Punjab: Pointed Appliqué Design (Source: Amna Tofique, 2013)

distance. Distinguishing feature of pointed appliqué wares of Sidduwala is the application of molding on the shoulder of the vessel which makes a sharp carination and border between the upper plain and lower appliqué body (fig. 3 a to d as on page 8; fig. 4) In few sherds these pointeds were so neatly formed they seemed like small pyramids looking very elegant, symmetric and harmonious. Sherds of figure 3 (a and b) SDW I / 29 and SDW I / 26 of represent the transitional wares of wavy and pointed appliqué while SDW 14 and SDW I / 17 of figure 3 (c and d) represent the consolidated form of pointed appliqué wares. Sidduwala potters were very vigilant in maintaining harmony among pointeds.

Floral Appliqué Decoration

In this variety appliqué is applied vertical to body profile, in hanging mode with horizontal leaves. One leaf is located above another leaf and all are connected with single vertical stem that runs bottom to top. Floral appliqué also seems to be evolved from wavy appliqué as few sherds show both wavy and floral appliqué and which also indicate that wavy appliqué is precursor of floral appliqué (fig. 5 a to d; fig. 6). In figure 5 (a and b), sherds SDW 13 and SDW 24 symbolise as intermediate appliqué of wavy and floral appliqué design with poor finishing and defaced leaflets while sherds of figure 5 (c and d), SDW 4 and SDW 9 embodied the fully established floral appliqué. Potter puts his concentration and focus in shaping each leaf and upholding a symmetric steadiness among all leaves presenting over all disciplined and ordered impression.

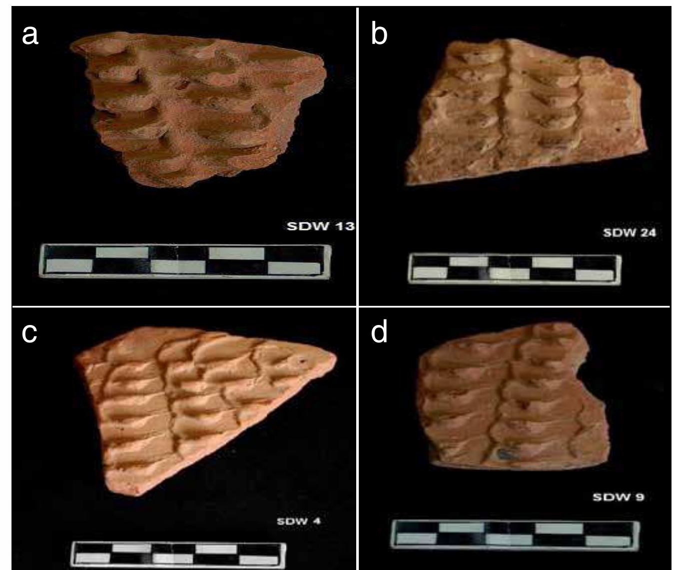


fig. 5 (a to d). Sidduwala/ Cholistan/ Bahawalpur/ Punjab: Upper Floral Appliqué Wares and Lower Mature Floral Appliqué Ware (Source: Adeel Hashmi, 2011-12)

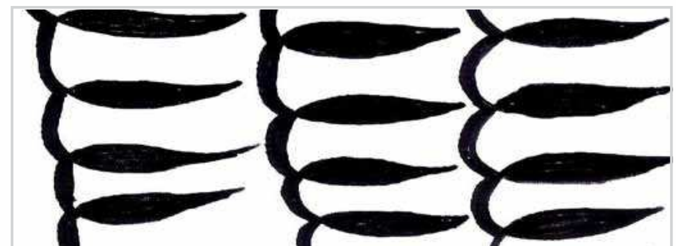


fig. 6. Sidduwala/Cholistan/ Bahawalpur/ Punjab: Floral Appliqué design (Source: Amna Tofique, 2013)

Curvature of these sherds in relation to width and height is large therefore it is evident that floral appliqué was mostly applied on elongated jars. A lot of care was taken in creating and finishing the floral appliqué because each leaflet is quite similar to other. Distinguishing feature of floral appliqué is its symmetry and the regularity of its execution. Whole appliqué is applied in single direction i.e. from right to left or left to right and executed from base to top. Irregular and rough floral appliqué is totally absent which shows the superiority of Sidduwala potter’s craft industry.

Diamond Appliqué Decoration

Fourth type is diamond appliqué decoration which in simple words means application of

thick mud slurry obliquely in a stylistic way that forms beautiful diamond patterns side by side. Some sherds seem to be early ones that exhibits rough or uneven diamonds shaped by application of mud carelessly. The sherds which show beautiful diamonds with defined and sharp edges and corners having equally thickened borders represent the mature form of the diamond appliqué. Few sherds exhibit combined features of wavy and diamond appliqué which is an evidence for the fact that wavy appliqué is ancestor of diamond appliqué. Another characteristic feature of diamond appliqué ware is the sharp carination executed at the shoulder below which diamond appliqué is applied. Further, shoulders of these diamond appliqué bearing vessels are well burnished and polished which makes the pot more graceful, elegant and smoother (fig. 7 a to d; fig. 8). In irregular diamond appliqué wares, appliqué is executed roughly; diamonds are of irregular shape which with the passage of time becomes defaced. In figure 7 a, sherd SDW IV / 13 acts as provisional ware of wavy and diamond appliqué and might be forerunner of diamond appliqué evidently from which sherd SDW II / 09 (fig. 7 b) is originated which is earliest or developing form of diamond appliqué with its curved edges. Sherds SDW II/ 28 and SDW II/ 32 in figure 7 (c and d) are mature diamond appliqué with their clear and demarcated edges.

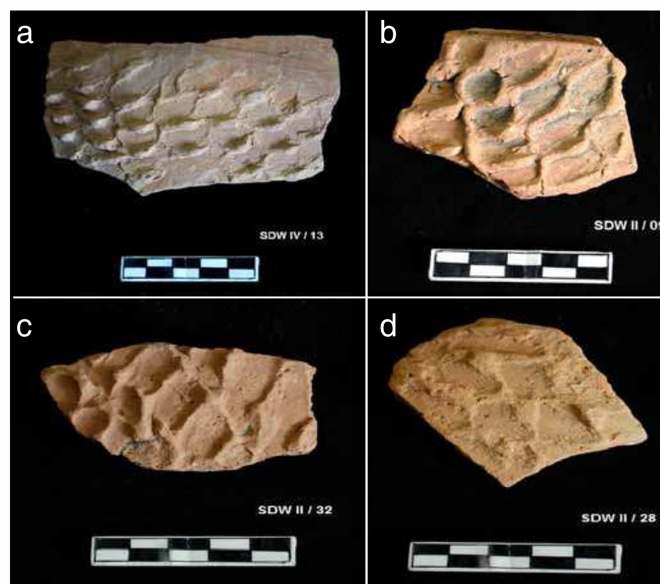


fig. 7 (a to d). Sidduwala/ Cholistan/ Bahawalpur/ Punjab: Upper Diamond Appliqué Ware and lower Mature Appliqué ware (Source: Adeel Hashmi, Dept. of Archaeology, University of the Punjab, 2011-12)



fig. 8. Sidduwala/ Cholistan/ Bahawalpur/ Punjab: Diamond Appliqué design (Source: Amna Tofique, 2013)

Latticed Appliqué Decoration

Latticed appliqué is formed by the application of stylistic clay art in which rectangular cells are formed both in horizontal and vertical direction. Regular and irregular latticed appliqué wares are found in equal numbers which indicate the moderate mastery of the potters in making of latticed appliqué. Sharp carination at the shoulder of the latticed appliqué vessels differentiate it from other appliqué bearing vessels. A distinctive feature of latticed appliqué is its luting technique by which latticed appliqué portion of these wares are joined with plain upper shoulder part as result of which a defined carination is formed and luting marks are also clearly visible. (fig. 9 a to d; fig. 10 as on page 11). In figure 9 (a and b), SDW II/ 30 and SDW V/ 21 epitomize the transitional appliqué of wavy and latticed appliqué. Both intermediating appliqué bear the thin coating of mud slurry which evidently make them smooth and non-porous like regular wavy appliqué. In figure 9 c, sherd SDW II/ 24 gave the earliest form of latticed appliqué in irregular manner, as one can observe that horizontal and vertical cells in this sherd are clearly visible. Sherd SDW 35 of figure 9 d shows mature latticed appliqué

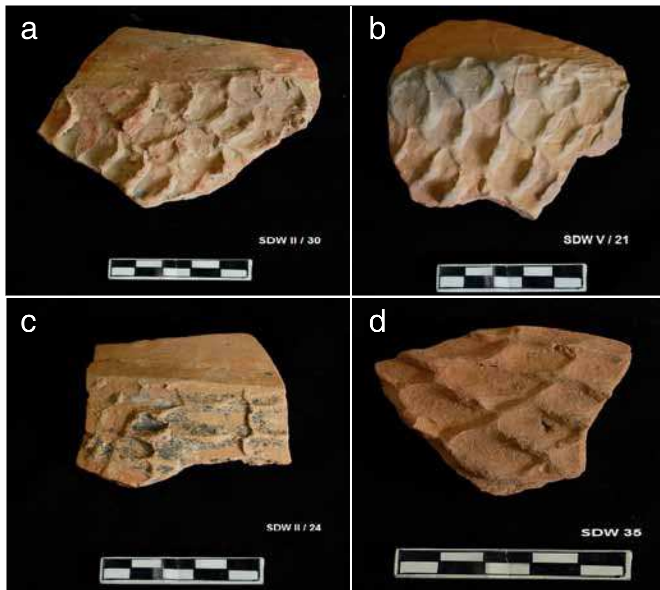


fig. 9 (a to d). Sidduwala/ Cholistan/ Bahawalpur/ Punjab: Upper Latticed Appliqué and Lower Mature Latticed Appliqué ware (Source: Adeel Hashmi, Dept. of Archaeology, University of Punjab, 2011-12)

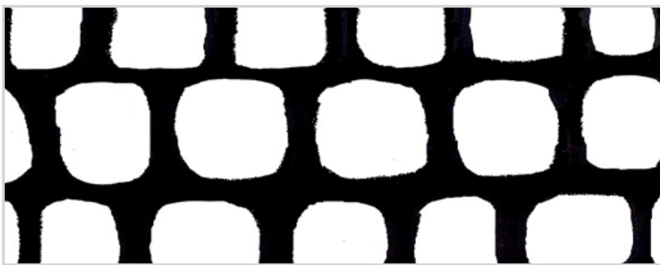


fig. 10. Sidduwala/ Cholistan/ Bahawalpur/ Punjab: Latticed Appliqué design (Source: Amna Tofique, 2013)

ware in which cells lie geometrically, each cell executed exactly below the upper one with outstanding finishing and making techniques.

Miscellaneous Appliqué Designs

This group contains various determined and undetermined types of appliqué with very limited numbers. Among them most prominent is rope appliqué of sherd SDW V / 19 in which three twisted and thin mouldings are applied, at short distance to each other and vertical to the body profile along with upper single and rounded self-moulding that is further incised obliquely with uneven compartments. One more sherd SDW / 43 bears a rounded self-moulding that is incised vertically below which a weird appliqué design starts. This strange appliqué is unfamiliar to all above, quite different in its manufacturing technique with miserable finishing and firing practice. Another peculiar type of appliqué is furnished on sherd number SDW 26 with upper applied moulding buttressed by the few small supports on left side below which an undetermined appliqué is applied. This appliqué is very surly and unsymmetrical and offers no impression about potter's strategy for its crafting. Sherd SDW II / 18 is embellished by an odd type of appliqué which comprises of upper square self moulding below which many vertical and parallel mouldings are applied, tapered from top to bottom. This is also an unusual form which gives no idea about its development, origin and gives dull appearance with poor aesthetics. On the whole, miscellaneous group comprises of mostly unique and new appliqué designs with some common features like upper mouldings that opened new chapters for researchers on the creativity and ingenuity of Sidduwala potters.

Discussion and Conclusion

For the understanding of cultural and ethnic developmental lineages, there have always been opinions and assumptions about how much ceramic documentation is really valuable and advantageous. Appliqué wares of Sidduwala comprises almost one-third of whole pottery corpus among which wavy appliqué seems to be earliest and parental. Rest of the categories evolved from the wavy appliqué as is verified from transitional appliqué wares, in which some single sherds bear wavy appliqué and evolving form of pointed appliqué, wavy appliqué combined with placental diamond appliqué, wavy appliqué along with primitive floral appliqué and similarly wavy appliqué along with embryonic latticed appliqué (fig. 11 as on page 12). Mostly appliqué wares are plain but in few circumstances appliqué coated with thin mud slurry with insignificant amount of sand which made the vessel

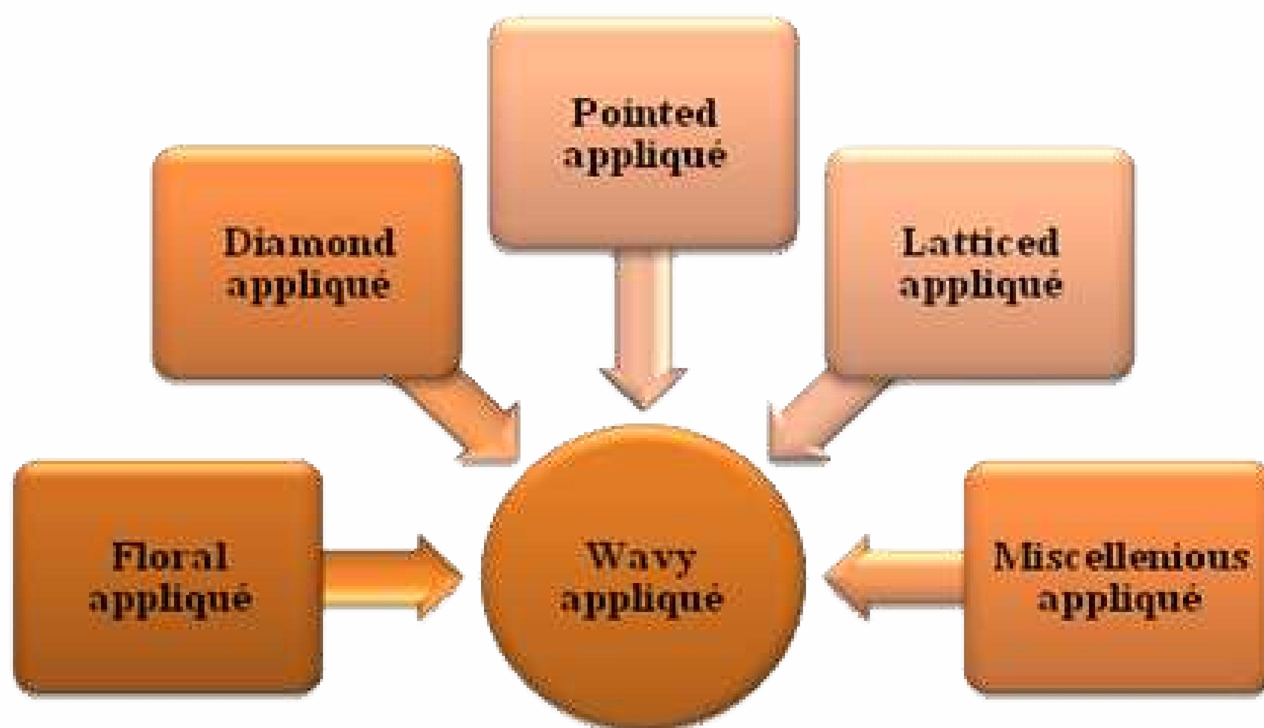


fig. 11. Connection of all Sidduwala appliqué designs with wavy appliqué

smoother to touch, decrease the porosity and remove the edges.

The site at Sidduwala appears to have been the center for production of appliqué ware during the late Harappan times at Cholistan. Due to the lack of availability of full pots at the site, it is not easy to picturse the whole vessel and it is challenging to determine whether the appliqué ware was also painted with black bands on the rim and the shoulder as described by the Dr Mughal (1997).

In whole of the Indus valley civilization not a single site exhibits such a large ratio of appliqué wares with abundant variety of designs and execution techniques even evolutionary lineages. Sidduwala presents all these characters with their reasonable evolutionary stages.

These appliqué wares constituting the appliqué of mud mixed with sand, show enormous variety of vessels displaying various manufacturing and decoration techniques, and appear to be conventionalised wares of Sidduwala used both for technical and stylistic purposes.

References

AHMAD, Farooq (2012) Spectral Vegetation Indices Performance Evaluated for Cholistan Desert, ***Journal of Geography and Regional Planning,*** 5(6).

FIELD, Henry (1959) ***An Anthropological Reconnaissance in West Pakistan, 1955,*** Peabody Museum Cambridge, Massachusetts.

FAIRSERVIS, Walter A. (1956) Excavation in the Quetta Valley, West Pakistan, ***American Museum of Natural History,*** 45(1).

FAIRSERVIS, Walter A. (1959) Archaeological Surveys in the Zhob and Loralai Districts, West Pakistan, ***Anthropological Papers of the American Museum of Natural History,*** 47(2).

MUGHAL, M. Rafique (1992) Jhukar and Late Harappan Cultural Mosaic of Greater Indus Valley, In: C. Jarrige (ed.) ***South Asian Archaeology 1989,*** The Prehistory Press, Madison, Wisconsin.

MUGHAL, M. Rafique (1995) Recent Archaeological Research in Cholistan Desert, In: S.P. Gupta (ed.) ***The Lost Sarswati and the Indus Civilizations,*** Kusumanjali Prakashan Publishers, Jodhpur.

MUGHAL, M. Rafique (1997) ***Ancient Cholistan, Archaeology and Architecture,*** Ferozsons (pvt.) Ltd, Lahore.

STEIN, Aurel (1995) Survey of Old Sites along the Hakra Bed, In: S.P. Gupta (ed.) ***The Lost Sarswati and the Indus Civilizations,*** Kusumanjali Prakashan Publishers, Jodhpur.

VANDAL, Sajda. H. et al. (2011) ***Cultural Expression of the South Punjab,*** THAAP, Lahore.

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Trace Element Analysis of Copper Objects from Bhirrana

Prabash Sahu

The Harappan mound at Bhirrana (Lat. 290 33' N; Long. 750 33' E) is situated in the Fatehabad district of Haryana on the right bank of the dried up River Saraswati (Rao 2005: 45-49). Excavated by L.S. Rao of the Excavation Branch-I, Nagpur, from 2003 to 2006, the site has yielded a four-fold cultural sequence, viz. Period IA: Hakra Wares Culture; Period IB: Early Harappan; Period IIA: Early Mature Harappan and Period IIB: Mature Harappan.

The Period IA represented by Hakra ware culture is characterised by subterranean circular dwelling pits. These pits are cut into the natural soil, the walls and floor of the pits plastered with yellowish alluvium of the Saraswati valley. Though no postholes had been found, the remains of burnt chunks of clay having reed impressions clearly speak of superstructures built of wattle and daub. The most distinguished feature of the period is the ceramic assemblage of the Hakra wares. The pottery is represented by mud appliqué wares, incised wares (both deep and light Incised), tan/ chocolate slipped wares, brown-on-buff wares, black-on-red wares, bichrome wares and plain red wares. The antiquities from the period included beads of carnelian, agate, jasper, lapis lazuli and steatite; bangles and sling balls of terracotta; pounders, sling balls and pestles of sandstone, hopscotch made on potsherds and crucibles; chert blade, bone point and a bangle and an arrowhead of copper.

Period IB represents the early Harappan culture. The structures of this period were built of mud bricks in the ratio of 3:2:1. A house complex having many living rooms and a central courtyard with chullahs was excavated. The pottery of the period comprised Sothi wares with all the six fabrics of Kalibangan I along with the pottery of the earlier period. The bichrome ware was found in good quantity. The painted designs included simple bands, rosettes, fish and pipal motifs. The important antiquities included fragment of a button seal made of shell; arrowheads, rings and bangles of copper; beads of semi-precious stones; pendent, bull figurine, bangle, rattle, cake, wheel, gamesman, marble and hopscotch of terracotta, bangles of faience, bone and stone objects.

The succeeding Period IIA represents the early mature Harappan phase. During this period, the site witnessed a change in the lay-out of the town planning. The entire city was encompassed within a fortification wall and the concept of twin cities came into vogue. Well laid out structures in grid pattern, made of pinkish mud bricks in the ratio of 4:2:1 were excavated. The pottery repertoire shows a mix bag of early Harappan and mature Harappan pottery shapes and fabrics. The other antiquities comprised arrowheads, rings and bangles of copper; beads of semi-precious stones; cache of beads kept in pots; pendent, bull figurine,

bangle, rattle, cake, wheel, gamesman, marble and hopscotch of terracotta, bangles of faience, bone and stone objects.

The final period of occupation at the site represented the mature Harappan period. The site witnessed full-fledged maturity with all the characteristics of the mature Harappan times. The height of the fortification wall was raised. A burnt brick drain was provided in the thickness of the northern arm of the fortification wall to flush out the sewage and the rainwater. A good number of house complexes with as many as ten rooms, courtyard and veranda have been exposed. Two major streets, lanes and by-lanes have been excavated. The pottery of the period comprised the diagnostic pottery of the mature Harappan period. The painted designs included geometric, floral and faunal motifs painted in black on red wares. The antiquities comprised seals of steatite; imitation of the famous 'dancing girl of Mohenjodaro' on a potsherd in graffiti; arrowhead, bangle, ring, fishhook, two inscribed celts of copper; beads of semi-precious stones; stylised terracotta horns; spoked wheels of terracotta; animal figurines, bird-shaped whistle, rattle, spindle whorl, gamesman of terracotta, bone and stone objects of household uses.



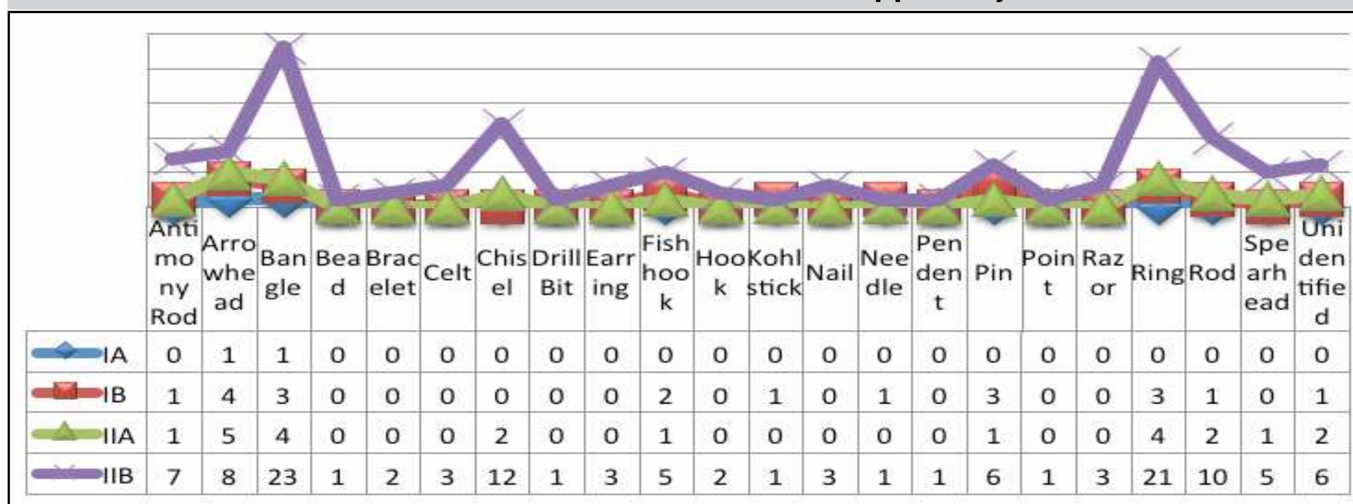
fig. 12. 1 and 2 from period IA and 3 to 16 from Period IB; fig. 13. Copper objects from period IIA; fig. 14. Copper objects from period IIB (discovered from Bhiranna)

A good number of copper objects (196 in total) have been reported from the different levels of the excavation. These objects include toiletries in the form of bead, pendent, rings, bangles and kohl stick and tools like arrowhead, fishhook, chisel, celt, etc. (fig. 12,13 and 14). These objects were prepared using the cold hammering technique. The Harappans at Bhirrana used to import copper ingots and melting and fashioning of the tools and objects were done at the site as attested to by a large number of crucibles. Few pieces are still found to be having the molten copper sticking to them (fig. 15).


fig. 15. Bhiranna: Crucibles from Period IA

A total number of 41 objects (1 from Period IA, 9 from Period IB, 2 from Period IIA and 29 from Period IIB) as shown in chart 1 were sent to the Indira Gandhi Centre for Atomic Research, Kalpakkam for Trace Element Analysis to ascertain composition of the metal and their possible source of extraction by comparing with the present copper ores. These objects were analysed by a team of scientists from the Quality Assurance Division, Engineering Service Group of the Indira Gandhi Centre for Atomic Research, Kalpakkam led by Dr B. Venkatraman using X-Ray Fluorescence (XRF) [X-Ray fluorescence is the emission of "secondary" (or fluorescent) x-rays from a material that has been excited by bombarding with high energy x-rays) method with the equipment NITON XLT 898]. The detail of the elemental analysis as shown in chart 1 is enumerated in table 1.

Chart 1. Period-wise Distribution of Copper Objects



	Antimony Rod	Arrowhead	Bangle	Bead	Bracelet	Celt	Chisel	Drill Bit	Earring	Fish hook	Hook	Kohl stick	Nail	Needle	Pendent	Pin	Point	Razor	Ring	Rod	Spearhead	Unidentified
IA	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IB	1	4	3	0	0	0	0	0	0	2	0	1	0	1	0	3	0	0	3	1	0	1
IIA	1	5	4	0	0	0	2	0	0	1	0	0	0	0	0	1	0	0	4	2	1	2
IIB	7	8	23	1	2	3	12	1	3	5	2	1	3	1	1	6	1	3	21	10	5	6

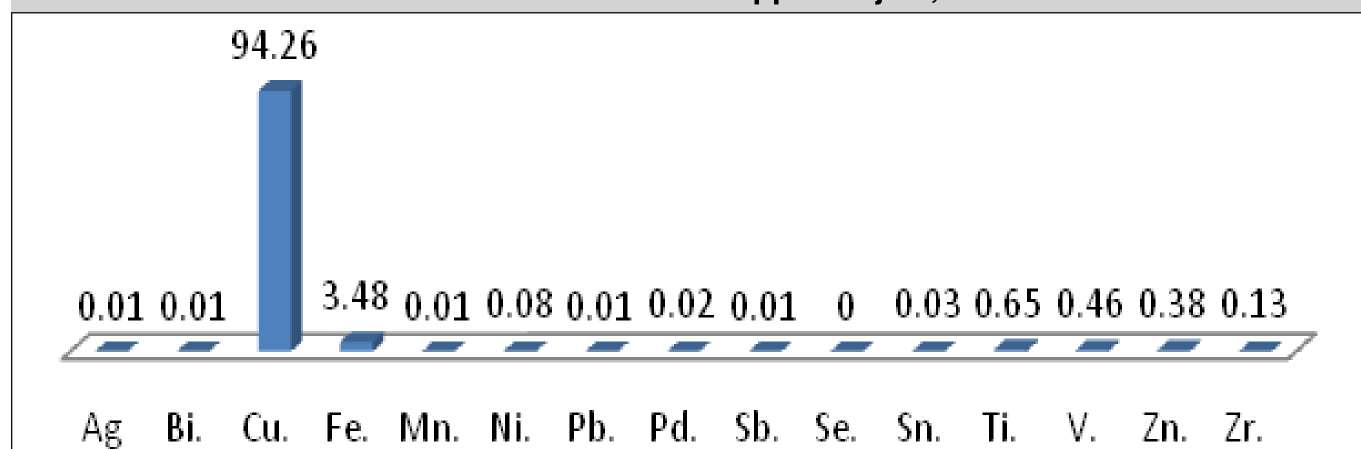
Table 1. Elemental Analysis of Copper Objects from Bhirrana

Reg.No.	Ag	Bi.	Cu.	Fe.	Mn.	Ni.	Pb.	Pd.	Sb.	Se.	Sn.	Ti.	V.	Zn.	Zr.
7622	0.22	0.05	94.08	4.11	0	0.1	0.01	0.16	0.09	0	0.33	0.01	0.38	0.25	0.13
695	0.01	0.01	94.26	3.48	0.01	0.08	0.01	0.02	0.01	0	0.03	0.65	0.46	0.38	0.13
708	0.11	0.03	98.88	0.52	0.01	0.37	0.04	0	0	0	0	0	0	0.02	0
873	0.16	0.01	96.37	0.57	0.05	1.8	0.01	0.23	0.01	0	0.43	0.01	0.01	0.02	0.01
1256	0.13	0.1	98.7	0.26	0.03	0.01	0.01	0.08	0.26	0.12	0.19	0	0.09	0.01	0
2538	0.3	0	79.14	2.29	0	0	6.99	0.08	0.45	0	2.6	0	0.34	7.59	0.02
2807	0.12	0.03	97.85	1.34	0	0.03	0.03	0.01	0	0	0	0	0.08	0.32	0.03
3466	0	0.01	96.66	2.71	0.03	0	0.07	0.07	0	0	0	0	0.08	0.16	0.12
3469	0	0.01	92.84	4.36	0.08	0.01	0.13	0.11	0	0	0.69	0.8	0.25	0.44	0.11
3629	0.05	0.09	94.48	3.27	0.05	0.12	0.04	0.17	0.16	0	0.19	0.77	0.01	0.33	0.12
3705	0.06	0.01	96.83	1.88	0.05	0.04	0.91	0	0	0	0	0.01	0.04	0.04	0.03
4004	0	0.01	95.27	2.37	0	0.01	0.03	0.01	0	0	0.03	0	0.09	0	0.03
2537	0.17	0.12	92.93	5.6	0	0.05	0.27	0.03	0	0.02	0	0.01	0.18	0	0.2
2582	0.29	0.04	92.38	5.61	0.04	0.04	0.17	0.13	0.01	0.01	0	0.23	0.03	0	0.49
239	0.12	0	93.15	4.39	0	0.05	0.14	0	0	0.01	1.7	0	0	0	0.09
267	0.19	0	97.4	0.92	0	0.03	0.25	0.05	0	0.01	0.26	0	0.07	0	0.02
281	0.1	0.03	90.53	3.08	0.12	0	0.03	0.02	0	0	5.1	0.39	0.19	0.21	0.08

Reg.No.	Ag	Bi.	Cu.	Fe.	Mn.	Ni.	Pb.	Pd.	Sb.	Se.	Sn.	Ti.	V.	Zn.	Zr.
300	0.12	0	99.42	0.06	0.04	0.2	0.09	0.01	0	0	0.05	0	0	0	0
302	0.11	0.02	98.93	0.11	0	0.08	0.14	0.03	0.2	0	0.07	0.15	0.1	0.02	0
303	0	0.04	95.6	2.82	0	0.54	0.28	0.09	0	0.01	0.09	0	0.13	0	0.02
304	0.01	0.01	98.13	0.55	0.02	0.11	0.41	0.05	0	0.02	0.27	0.01	0.01	0	0.02
340	0.09	0.02	95.81	0.2	0.03	0.39	0.14	0.02	0.05	0	0.21	2.26	0.22	0.37	0
414	0.14	0.04	96.32	0.26	0	0.16	0.12	0.06	0.14	0.01	0.27	1.75	0.2	0	0.01
449	0.37	0.17	91.56	3.68	0.2	0.08	0.06	0.01	0.22	0	0.06	2.07	0.46	0.71	0.03
647	0.21	0.01	98.25	1.16	0	0.06	0.12	0.05	0.05	0	0.02	0	0	0	0.02
649	0.19	0.04	96.09	2.55	0	0.08	0.01	0.03	0.18	0.01	0	0	0.22	0	0.19
711	0.23	0.32	70.65	1.6	0	0	23.83	0.01	0.13	0	0.9	0	0	2.25	0.04
813	0.14	0	98.95	0.66	0	0.02	0.02	0	0	0	0.01	0	0.07	0	0
1017	0.11	0.01	98.82	0.36	0	0.07	0.02	0.04	0.09	0	0.11	0	0.18	0.17	0.01
1145	0.16	0.05	97.9	0.87	0	0.13	0.16	0.03	0.02	0	0	0	0.36	0.26	0.02
1615	0.25	0.04	96.47	0.38	0	0.11	2.39	0.01	0.04	0	0.13	0	0.08	0	0.01
1863	0.16	0	99.01	0.41	0	0.05	0	0.01	0	0	0.08	0	0	0.22	0
2138	0.2	0.01	98.94	0.13	0	0.01	0	0.01	0.05	0	0.04	0	0.09	0.4	0.01
2150	0.09	0	99.46	0.04	0	0.24	0.01	0.01	0.05	0	0.05	0	0	0	0
2594	0.01	0.04	94.73	3.36	0.01	0.65	0.18	0.1	0	0.01	0	0.06	0	0	0.12
2882	0.12	0	89.33	0.35	0	0.14	0.13	0.03	0.15	0	9.06	0	0.07	0.15	0.01
2907	0.22	0.01	98.4	0.42	0	0.17	0.01	0	0.01	0	0	0	0.1	0.49	0
2952	0.05	0	98.96	0.39	0.02	0.02	0.04	0.06	0.19	0	0.06	0	0.	0.14	0
3207	0.11	0	98.14	0.94	0.02	0	0.04	0.03	0	0	0.13	0	0.07	0.46	0.02
3382	0.44	0.08	93.2	3.53	0	0.01	0.85	0.15	0.04	0	0.91	0.01	0.07	0.24	0.05
3673	0.16	0	94.28	2.03	0.08	0.05	0.24	0.01	0.41	0	0.27	1.97	0.01	0.33	0.07
3810	0.17	0.02	95.12	2.97	0	0.05	0.86	0.02	0	0	0	0	0.31	0.28	0.14
4003	0.16	0.01	97.35	2.07	0	0	0.17	0.03	0	0.01	0	0	0	0	0.02

As mentioned earlier, only one object from Period IA was analysed. The analysis shows that the major element present is copper (94.8%) followed by iron (4.11%), vanadium, tin, zinc, silver, palladium, zirconium, nickel, bismuth, lead and titanium - all in less than 1% (as shown in chart 2).

Chart 2. Trace Elements of Copper Object, Period IA



Of the 11 objects analysed, the percentage of copper is in the range of 92.84% to as high as 98.88%. The next prolific element is iron and range to a maximum of 4.36%. The other elements like vanadium, tin, zinc, silver, palladium, zirconium, nickel, bismuth, lead, antimony and titanium are in less than 1% except in object bearing the Reg. No. 2538 which has a less percentage of copper (79.14%) and high percentage of zinc (7.59%), followed by lead (6.99%), tin (2.6%) and iron (2.29%) (as shown in chart 3).

Two copper objects from Period IIA were analysed and they show uniformity as far as their elemental compositions are concerned (as shown in chart 4). The percentage of copper is as high as 92.93% and iron in the range of 5.6%. The other elements are in the range of less than 1%. Tin and zinc are totally absent in these specimens.

Chart 3. Trace Elements of Copper Objects, Period IB

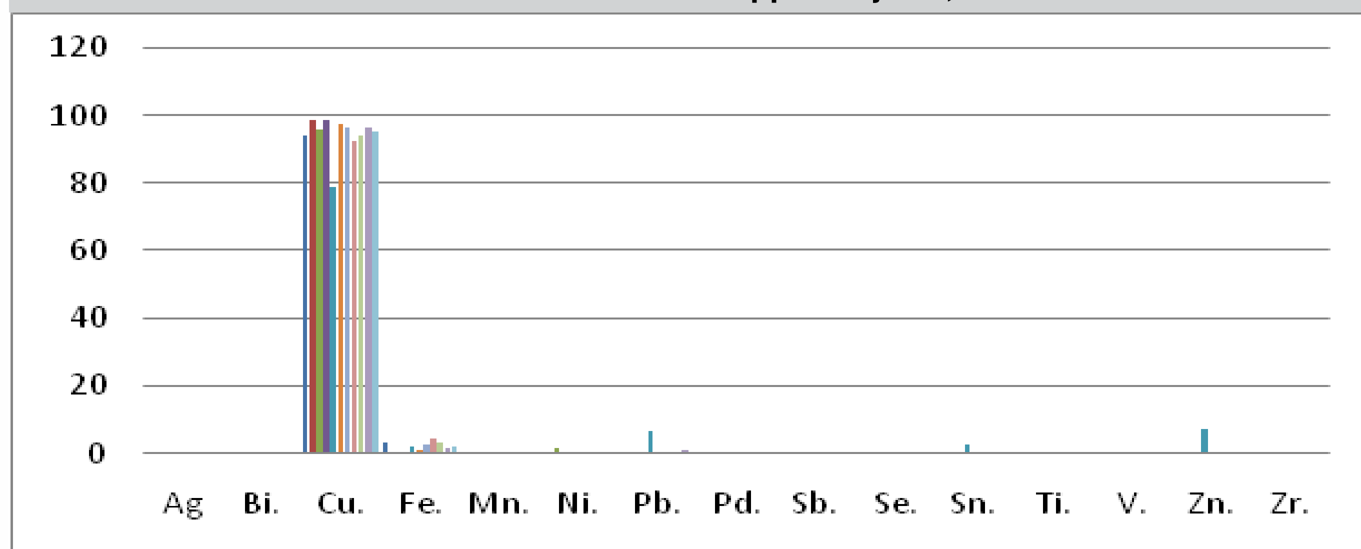
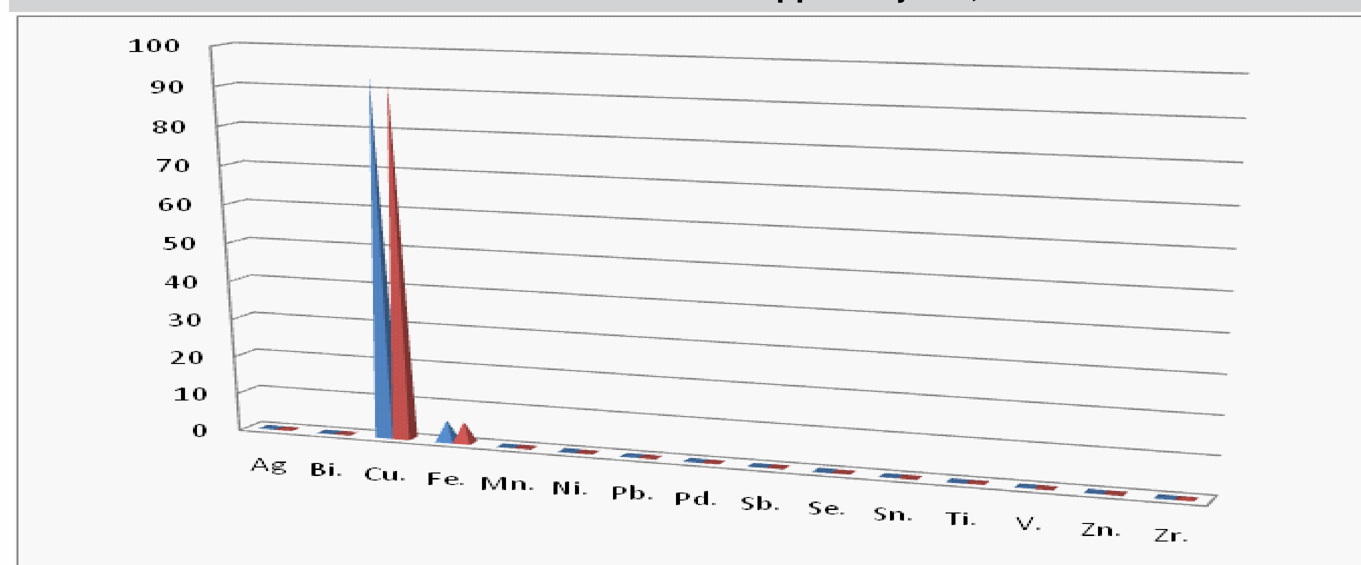
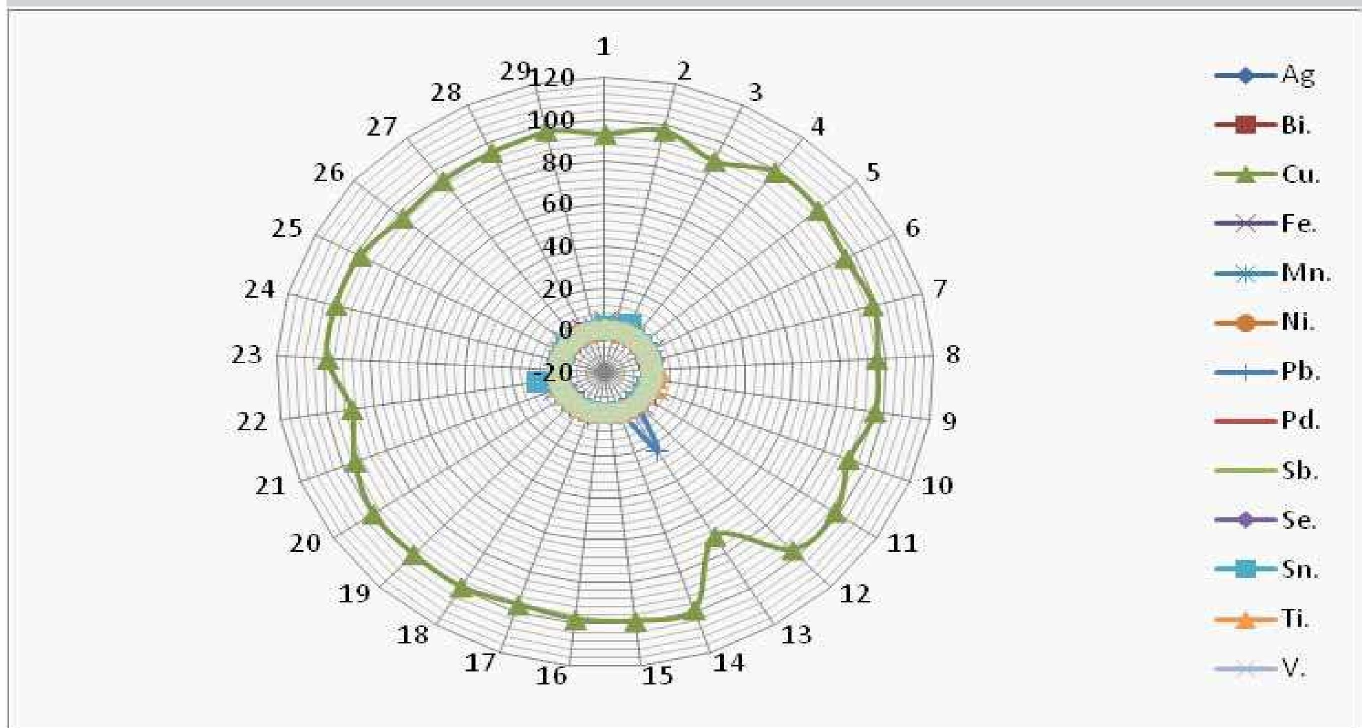


Chart 4. Trace Elements of Two Copper Objects, Period IIA



The analysed copper objects from Period IIB show the presence of copper in the range of 90.53% to as high as 99.46% whereas iron stands out as the second element with a range up to 4.6%. However, two samples deserve special mention. The object bearing Reg. No. 281 has 90.53% of copper, 5.1% of tin and 3.08% of iron. Similarly the specimen bearing Reg. No. 711 contains 70.65% of copper, 23.83% of lead, 2.25% of zinc and 1.6% of iron as shown in chart 5.

Chart 5. Trace Elements of 29 Copper Objects, Period IIB



possible ore for extraction? The chalcopyrite ore from Khetri shows the presence of silver, iron, arsenic, antimony, lead, bismuth, copper, tin, nickel, zinc, manganese, cobalt, aluminium, chromium, molybdenum, titanium, magnesium, vanadium and silica. The spearhead from Mohenjodaro and a Celt from Chanhudaro show exactly the same properties as in the Khetri chalcopyrite. The samples from Bhirrana do not have the elements like arsenic, cobalt, aluminium, chromium, molybdenum and silica. Taking into consideration the high

Observations

The Trace Element Analysis of the copper objects from Bhirrana show that the Harappans at Bhirrana throughout its occupation used the copper procured from the same source albeit some aberrations noted in one sample from Period IB and two samples from Period IIB.

Now the questions arise where from the metal was being brought to and where was the

percentage of copper, it may be surmised that these impurities were filtered before the preparation of the ingots. Can it safely be assumed that the copper used by the Harappans belonged to the Khetri mines is a valid question yet to be answered with utmost conviction.

While dealing with the metal technology of the Harappans, D.P. Agrawal (1984: 163) opines, “deliberate alloying as addition to more than

1% of the alloy metal to copper, lesser amounts may be due to impurities in the ore itself." The observation made by D.P. Agrawal seems to be highly improbable as the presence of iron in the copper objects from Bhirrana as well as Kalibangan is too high (Lal 2003: 165-166). At Kalibangan, it varies from 1.04% to as high as 8.5% which is too high and certainly the Harappans had no knowledge of the black metal. The most plausible explanation here can be that the elements were the inherent impurities in the ore itself and the Harappans had no knowhow or interest to filter these impurities as these had no bearings on the desired strength of the objects which they prepared.

Acknowledgements

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References

AGRAWAL, D.P. (1984) Metal Technology of the Harappans, In: B.B. Lal and S.P. Gupta (ed.) ***Frontiers of the Indus Civilization***, Books and Books, New Delhi.

LAL, B.B. et al. (2003) Excavations at Kalibangan - The Early Harappans (1961-69), ***Memoirs of Archaeological Survey of India,*** 98.

RAO, L.S., Sahu, N.B., Sahu, P., Diwan, S., and Shastry, U.A. (2005) New Light on the Excavation of Harappan Settlement at Bhirrana (2003-04), ***Puratattva,*** 34.

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Megalithic Cultural Tradition Amongst the Lesser Known Tribal Communities of India with Special Reference to Tribes of Central India and Khasi Tribes of Northeast India

Vinay Kumar and Sulekha Banerjee

Etymologically speaking the word 'megalithic' is derived from two Greek words 'mega' meaning huge and 'lithic' meaning stone; hence, it denotes a huge stone. The term 'megalith' may be explained as 'a grave or memorial erected in stone, whether dressed or in its natural form containing, enclosing or erected over the funerary assemblage'. Megalithic culture has no regional bounds as its cultural remnants are found all over the world. These monuments are found in Europe, Africa and Asia, including in the far eastern countries. In the neighbourhood of the Indian sub-continent, the presence of this culture is noticed in Iran and Baluchistan, extending up to Pakistan. In northern India, this culture is sporadic in occurrence as compared to south India.

Gordon Childe thinks that the early centres of Megalithic architecture were situated near the Mediterranean, the Atlantic and the North Sea. According to him, it was from this region that the dolmen and the port-hole slab reached the Indian peninsula. According to Gordon Childe it is not likely that the megaliths in south India were affected by land borne impulses from Iran but were rather exposed to maritime influences (Childe 1948: 4-13). But Dikshit (1969: 10) in his paper on 'The origin and Distribution of Megaliths in India' opines that the Indian megaliths appear with different traits introduced by different people at different times.

Megalithic Tradition Among the Tribes of Central India

Megalithic practices are observed by aboriginal tribes of India even to this day. This practice is noticed among Gadaba, Bondo and Munda tribes in districts of Koraput and Keonjhar in southern Orissa. It is usually believed that the Kol and Gond communities of Central India were megalith builders, and some cultural-continuity of this practice survives, with the erection of smaller standing stones. They still use the stone circles which is directly influenced by those of Baluchistan, Pakistan and the Makran region (Banerjee 1966: 163-175). Menhirs are also found in abundance among these tribes of Central India.

Among the tribal populations of India, the Gonds stand out by their numbers, the vast expanse of their habitat and their historical importance. Gondi or Gond people belong to the Central India and are spread over the states of Chhattisgarh, northern part of Andhra Pradesh, Madhya Pradesh, eastern region of Maharastra, and western part of Orissa. They are the largest tribe in Central India. They are actually a part of the large tribal category, which includes the Santhal and the Bhil tribal communities. Also, the Gond tribes identify themselves as 'Koytoria'. If one traces out the origin of the word Gond, one finds no difficulty to find out the fact that this has been taken from the Telugu word 'Konda' which signifies hill.

Also there are several surveys that have been carried out in the region, which has thrown some light on the total population of the Gond tribes. It has been enumerated to be more than four million thus making the Gond tribes the largest tribal community of the Central India. The social structure of the Gondi people is divided into four basic categories namely Madia Gonds, Raj Gonds, Dhurve Gonds and Khatulwar Gonds. The Gondi tribes are categorised into three major sub-castes namely Muria, Maria, and Dorla. Some of the evidences of megalithic structures of their time still exist in some parts of their dominion. The Stone Age burial practice, however, has disappeared in Europe, Latin America and many parts of Asia. But the "grave art" continues to flourish in Gond tribal pockets of Chhattisgarh's Bastar region (Russell 1916: 520-526). Adivasis converging at the village burial ground, performing cremation or burial rituals for the dead clan member amidst recital of "hanal pata" (burial song in tribal Gondi dialect), beating of drums in a melancholic rhythm, and then raising memorials to "preserve the soul of the dead" is still a common sight in remote tribal areas of Bastar. The architectural designs of the memorial structures found in different places in Bastar are as varied from each other as possible. As the Stone Age legacy, dating back to the Iron Age in India, passed on to the successive generations, the Bastar tribals have continued the tradition. Bastar being one of the most primitive centres of the tribal culture has the most exclusive and ancient pattern of culture in relation to the Megalithism as is followed in the means of death ceremonies mainly in tribal context which is still being followed by the occupational tribes though with many modifications. Among the tribes who are following this culture, the main are the Gondis and with the gradual development of time the off shoots of this tribes also followed this culture. They are Marias, Dorlas as well as Dhurwas. Among the category of Marias we have two divisions; one is the Abujhmaria and another is the Dandami Marias. The former's role is not significant in this relation but the latter one is the legendary follower of this cultural pattern.

The megaliths here are broadly classified into four categories — Menhir, Cist, Cairn Circle, and Cap Stone. In Bastar, basically menhir type (large standing stones) of megaliths are noticed. Currently three tribal groups — Marias, Dorlas and Murias — practice the megalithic culture. Earlier, Gond tribals of Kanker in Bastar also observed this tradition, but they discontinued it long back. The tradition, according to anthropologists, has come to Bastar from the Indonesian archipelago and to the north-eastern region of India, and Orissa through Myanmar. Stone slabs used for building the tombs are engraved with what is the depiction of the culture of the clan to which the dead belonged, along with the deceased's own life and achievements. Figures of animals, birds, men and women are also found in the engravings. The motifs also illustrate the dead person reaching heaven riding on an elephant. The articles used by the deceased are also buried under the memorial along with an iron ring, in which the local priest "entraps" the departed person's soul by performing some complex rituals. The rituals associated with the burial ceremony are very expensive, as it involves a feast for the clan members and even slaughtering a cow. However, in many cases, tribals, who cannot afford the practice, are forced to postpone it.

Gonds of Bastar reveals a fusion of cultures which has not only taken place in the past but is going on in the present. The practices of erecting a dolmen as a seat for a village elder, for the 'Village Mother' or for the ghost of a dead person to sit on, a circle of stones for the village panchayat and a memorial menhir in the

village of ancestral origin, together with a belief in a collective clan soul and what amounts to a form of ancestor-worship recall very strongly the Sawara, Munda and Khasi cultures, while they link up with other similar practices of the megalithic cultures farther east, e.g. in the Naga hills, Mentawi, farther Asia generally and even the Pacific. The belongingness to the same group of cultures is again suggested by the use of a communal bachelor's hall, of the sago palm and of grass rain-coats, by stilt-walking and by the making of fire by means of a fire-saw instead of a drill. Reference has already been made to the megalithic culture of the Maria, now apparently rapidly decaying. Here again, much is suggestive of various Assam and Indonesian cultures. Menhirs are transported as by Lhota Nagas and erected as by the Angami, while stone cists are put up by the village path. Seed is fertilised with blood, suggesting not only the Khond meriah sacrifice, but also the general theory underlying the head-hunting practices of Naga, Wa, Kayan, Igorot or Taigal from Assam to Formosa.

The Kol are an ancient tribal community, one of the original inhabitants of northern and central India. Korku is a scheduled tribe (ST) community predominantly found in the East Nimar (Khandwa and Burhanpur), Betul and Chhindwara districts of Madhya Pradesh and adjoining areas in Melghat region of Maharastra in India speaking the Korku language, which is a member of the Austroasiatic language family. Korkus have derived their name from the combination of the word 'koru' meaning man and 'ku' which makes it plural meaning tribal men. The Korkus are a branch of the great Munda tribes and are placed here in the vicinity of the great tribe - the Gonds. Korkus are initially believed to be a hunting-gathering community dwelling in the forests of Satpura ranges on either sides of the River Tapti. These two tribal communities are also still practising the megalithic tradition in central India.

Megalithic Culture Among the Khasi Tribes of Northeast India

The North-East region comprises the seven states of Assam, Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland and Tripura. It has different cultural, linguistic, religious and ethnic races. The races which dwelt upon the region since remote antiquity are the Austrics, Mongolians, Dravidians and Aryans. Migration of all these races had contributed the development of composite culture in this region (Ashraf 1998: 64-76). The megalithic culture is widespread in the region. A notable feature is the prevalence of these customs in some of the tribal communities of the region. Table stone and menhirs were being erected after remarkable events of social importance. Typologically these are classified broadly into three categories viz. menhirs, dolmen and stone cists. Menhirs and dolmens are the monumental groups. Menhirs are found erected in the line of three, five, seven, etc. whereas the dolmens are usually built in front of the menhirs. Origin of this tradition in this part of the country is perhaps influenced by the Southeast Asian megalithic tradition during the first half of the first million BCE and perhaps ended during the first century CE. Date of origin of these megalithic traditions, however, is problematic. Some believe that this tradition was spread to this region from the west.

According to Christoph von Fürer-Haimendorf's observation they belong essentially to south-eastern Asia-Indonesia, Oceania, the Philippines, Formosa and were introduced into Northeast India by Austro-asiatic immigrants (Heimendorf 1945: 73-86). The Khasis and Nagas of Assam erect single standing stones

(menhirs) or alignments of stones in honour of the dead, who are thereby encouraged to help their living kinsmen. In Assam, as well as in Indonesia and Oceania, a forked wooden post of Y-shape is an alternative to the menhir, and both posts and menhirs are associated with ox-sacrifice. An identical custom occurs in Bastar; and the Koyas and Raj Gonds of Hyderabad erect small forked posts carrying the tails of sacrificial cows on graves or the site of memorial feasts. In all these regions it is a widespread belief that the soul or 'virtue' of the dead man is attached to the stone or post and benefits his survivors and the village-crops.

One of the striking features of the Khasis is the Megalithic culture whereby they erect megaliths, monoliths, cromlech and dolmens over which lie the foundation of prehistoric origin. It is astonishing to see that this culture is found to be associated with ancient people from all over the world such as the Monkhmer group of Southeast Asia. Such practices of the erection of stones are found in France and other parts of Europe. The Khasis indeed approach more nearly to the dominant megalithic custom of peninsular India in that they collect periodically the bones of clan-members and deposit them in a free-standing cist, as big as a small house, built of enormous single slabs. The significant aspect of the megalithic tradition is that the tradition is still in practice in some of the pocket areas of the tribal communities in the Khasi and Jaintia Hills. Some of the megalithic sites in the Meghalaya are Nartiang, Cherrapunji (fig. 16), Jowai, Maoflong, Lailugkot, etc. Amongst several other sites in Ri-Bhoi District of Meghalaya like Mawrong, Mawbri, Iapngar, Tyrso, Umswai, Amjong, Umbi, Nongkhrah; Umjajew, San-Mer, Nongpyiur-Myrkhan and Tynring in East Khasi Hills District; sites around Shilian Myntang-Chei Bnai in Jaintia Hills



fig. 16. Cherrapunjee, Meghalaya: Megaliths

District, and Nongspung and Wahlang of West Khasi Hills District, the site of Sohpet-Bneng Hill in Ri-Bhoi District situated north-east of Umiam-Barapani site deserves a special mention due to its association with the Khasis as their ancestral site.

The Khasis generally erect a monolith as a tribute to a dead person which is done immediately after the cremation. These monoliths are comprised of a set of flat upright stones. The upright stones or the menhirs are known as mawsynsang or the milestone and the table stone or dolmens are known as mawkynthei or the female stone. Menhirs or pillars stand upright, their bane being dumped inside and the dolmens lie flat in the front. They are known a Mawkjat which are laid during cremation of the deceased or during the disposal of the ashes of the demised members of the house. Mawknaii maw pyrsa commemorating the seniors or juniors usually vary from three tall pillars to eleven or more and are associated with two or more dolmens.

The megalithic monuments of Nartiang are significant because of their larger dimension. Some of the monuments are very big and even 9 m high. Nartiang used to be the summer capital of the Jaintia Kings of the Sutnga state. The



fig. 17. Nartiang, Shillong, Meghalaya: Megaliths

megaliths here are huge granite slabs probably hewn out by the fire setting method (fig. 17). The huge monolith, is said to be erected by Mar Phalyngki, a Goliath of yore. The Nartiang menhir measures 27 feet 6 inches in thickness. The monoliths represent the megalithic culture of the Hynniewtrep people representing thus the stonehenge of Northeast India. The types of the megalithic monuments are menhirs, dolmens and cairns. The stone cairns are the monuments of upright stones in square or circular plan fitted closely. The stone cairns contain the bones of the family members or clans. These are deposited periodically after removing one flat stone. The calcified bones and ashes of the deceased are collected from time to time in an earthen jar and deposited in the cist. The dolmens are differed from the cist structurally as well as in content. Structurally dolmens are comprised of flat table stones and upright stones. But unlike stone cairns these do not contain any bony remains or ashes in jars. The third variety is the monumental groups of menhirs. They are comprised of huge stone slabs erected over the ground.

Conclusions

Hence, the megalithic culture survives today only in Bastar and its adjoining areas in Andhra Pradesh and Orissa. Unfortunately today this tradition continues in very few pockets of north-eastern states of India, and is not profusely practiced here as seen in Bastar. Though the concept of Megalithism has changed a lot from that what was during the time of crude and rough megaliths to the present cemented cenotaphs and the painted memorial, but what yet pleases is the basic core concept of the whole, which is unchanged. However, today there are many obstacles in the way of protection of the practice of this culture among the future generations as the main constrain is the expenditure of the feast which the deceased's relatives have to bear at the time of the installation of the memorial. The second obstacle has been occurred because of anti-laws and political scenario. As many political fractions are trying their best to create political advantages over the sensitive issues related with megalithism which is why these tribal communities think twice before performing such sacrifice which is a must according to their tradition.

Besides this, authors have observed that today's tribal groups wants to develop themselves as far as possible which is worth applauding but not at the cost of their own separation from their cultures. However, certain exceptions are there as past customs such as megalithism lacks seriousness in present-day tribal group practices. As far as awareness is concerned, authors have noticed that there have been some efforts on creating awareness in the state by the Archaeological Survey of India. For protecting the wooden memorials, shelters are also being constructed over them. Apart from it, newly painted blank boards are still waiting for information which has been recently fixed near the fenced protected area.

References

ASHRAF, A.A. (1998) Archaeological Remains and Further Prospects in Arunachal Pradesh, ***Puratattva,*** 28.

BANERJEE, N.R. (1966) The Megalithic Problem of India, In: D. Sen and A.K. Ghosh (ed.) ***Studies in Prehistory***, Firma K.L. Mukhopadhyay, Kolkata.

CHILDE, V. Gordon (1948) Megaliths, ***Ancient India,*** 4.

Dikshit, K.N. (1969) The Origin and Distribution of Megaliths in India, ***Seminar papers on the Problem of Megaliths in India,*** Banaras Hindu University, Varanasi.

HEIMENDORF, C. Von Furer (1945) The Problem of Megalithic Cultures in Middle India, ***Man in India***, 25.

RUSSELL, R.V. (1916) T***he Tribes and Castes of the Central Provinces of India,*** vol. 3, Macmillan, London.

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Prabhasa Kshetra and its Association with Sun Worship

Kanan Ramkrishna

Introduction

Prabhasa Kshetra, the name itself evokes a religious feeling inside us. This famed Puranic region comprises various pilgrim places, out of which the Somnath temple, one of the twelve jyotirlingas is the most famous. It is situated in the town of Prabhas Patan, around 7 km from Veraval, in the southern coast of Junagadh district of Saurashtra peninsula in Gujarat.

This work is about exploring the Prabhasa Kshetra in the light of its association with Sun worship. This region is not confined to the Somnath temple and the Prabhas Patan town but is extensive.

Prabhasa Kshetra in Skanda Purana

Prabhasa Kshetra is eulogised in the Epics and the Puranas. The epic heroes of the Mahabharata have visited the land of the Prabhasa. Puranic literature is vast and exhaustive and is a compilation of genealogies, rites and rituals, legends and myths. It is a great source to understand the ancient Indian culture.

The Puranas formed a later form of the literature, at the time of synthesis of new and old ideas, when Hinduism was being metamorphosed to the religion of rites and rituals pertaining to the different sectarian gods. It seems as if it was the need of the hour to revise, reframe a section of literature which would befit the creed of the new worshippers and also the foreign influx, especially in the context of the Sun worship, which is said to have been reorganised with the help of the foreign influence of the Magi worshippers from Iran. Samba, the son of Krishna is credited to bring this influence and the Magi Priests to India and later on this new belief was thoroughly Hinduised.

Out of all the 18 Puranas, the most important one for this study is the Skanda Purana.

The Skanda Purana consists of seven large Khandas (books). Each Khanda is divided into various sub-Khandas and the Mahatmyas and these in turn are further divided into numerous chapters.

The main Khandas are:

1. Maheshwar, 2. Vishnu, 3. Brahma, 4. Kasi, 5. Avantya, 6. Nagara, 7. Prabhasa

For this study the Prabhasa Khanda of the Skanda Purana is the most important Prabhasa Khanda is divided into:

1. Prabhasa Kshetra Mahatmya
2. Vastrapatha Kshetra Mahatmya
3. Arvuda Khanda Mahatmya
4. Dvarika Mahatmya

In the sub-divisions of the Prabhasa Khanda, the Prabhasa Kshetra Mahatmya again is of importance for this study.

Geographical Positioning of Prabhasa Kshetra

The Prabhasa Kshetra Mahatmya gives the geographical positioning of the land of Prabhasa as (fig.18):

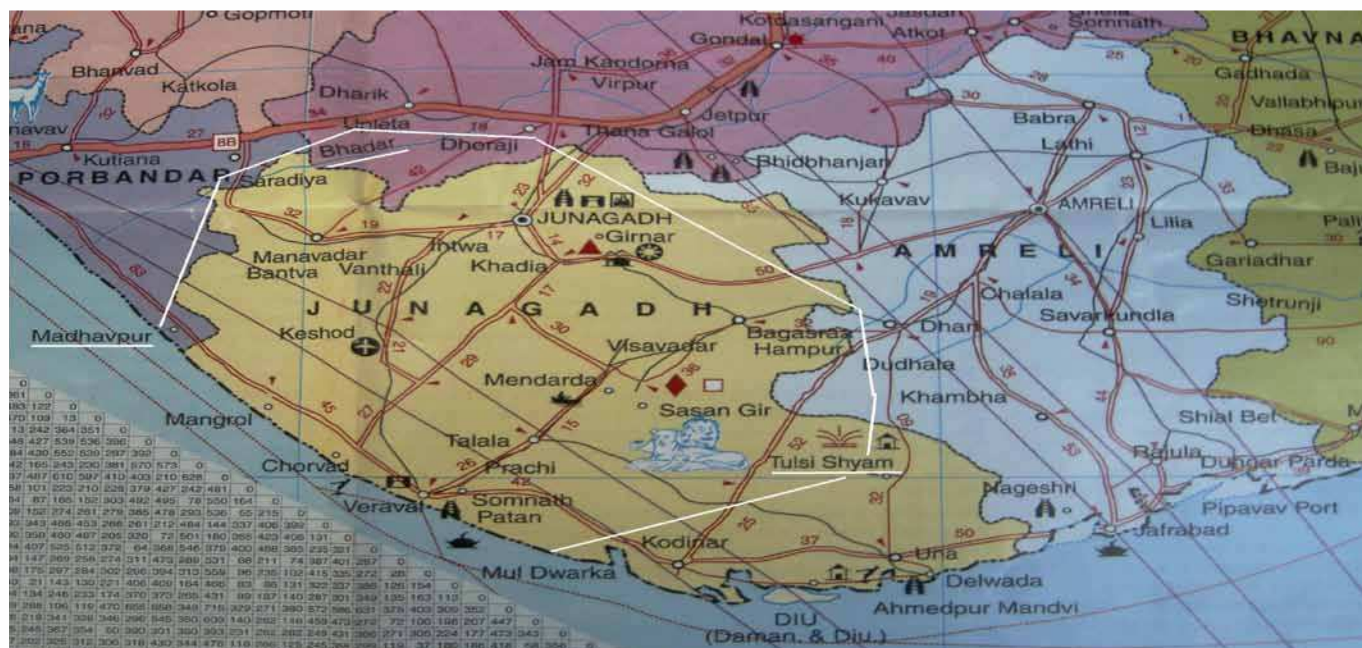


fig. 18. Map showing extent of Prabhasa Kshetra

Jambudvipa, the centre of the Earth, is divided into nine regions, which are known as Varsa, Bharata Varsa is one amongst these, situated in the southern most direction. To the south of Bharata Varsa is the Ocean and to its north the Himavan (Bhatt 2003a: SkP[1], Pkm[2], chapter 11, verse 6-14). In the south west of the Bharata Varsa is situated a region well known as Saurashtra. There are nine parts of this region and the ninth part of it is situated near the Ocean and well known as Prabhasa (Bhatt 2003b: SkP[1], Pkm[2], chapter 11, verse 37-39).

The extent of the Prabhasa is 12 yojanas (1 yojana = 12 km). To its south it extends up till the sea, to its north to the River Bhadra, to the west is Madhava and to the east is the Taptodaksvami (Bhatt 2003c: SkP[1], Pkm[2], chapter 4, verse 15-16).

The location to which the Prabhasa Kshetra extends to is quite clear and exists till date. River Bhadra in the north has been abbreviated to Bhadar and is a sacred river here; it flows through the districts of Rajkot, Junagadh and Porbandar. The Ocean in the south is the Arabian Sea. The western extension is up to Madhava, is a shrine dedicated to Vishnu (Bhatt 2003d: SkP[1], Pkm[2], chapter 299, verse 1-5), which can be interpreted as the flourishing town named Madhavpur in the Porbandar district with a temple dedicated to Lord Vishnu, which holds a great importance even today. The place in the east is the Taptodaksvami. The name Taptodaksvami means 'Lord of the hot water', there is such a place named Tulsi Shyam in the forest of Gir and is famed for the hot water springs and its medicinal properties. This Taptodaksvami is mentioned here in the Skanda Purana as the Talasvami, Vishnu the destroyer of the demon named Tala. Thus, a devotee should worship Vishnu who is established here with Rukmini, taking a dip in the Tapta-Kunda (hot water spring) (Bhatt 2003e: SkP[1], Pkm[2], chapter 330 and 332, verse 1-3). This place Tulsi Shyam too is dedicated to Vishnu. This place today could definitely be identified with the Tulsi Shyam, the modern name in all probability to the old Taptodaksvami, the 'Lord of hot water (springs)'.

The Refulgent Prabhasa Kshetra

Shiva, the narrator of this Mahatmya mentions the reasons behind naming the region Prabhasa. Besides the refulgence and splendour of His presence as the Jyotirlinga – the column of light, he also mentions the myth of Surya and Samjna. Vishwakarman scraping and carving the solar orb of Surya with a view to moderating it's fierceness as that was unbearable for His family members. A part of that scraping and carving of the solar orb fell over this region and thus it was named Prabhasa meaning refulgent.

This myth gives a clear idea about the change from worshipping Surya in his pure form to the acceptance of the new idea of the image of the deity.

The most important shrine here dedicated to Surya was by Samba, son of Krishna by the name Sambaditya, as he was cured of leprosy. He might have come to this region as the capital city 'Dwarika' was more approachable from this region than going northwards on the banks of Chandrabhaga (Chenab). Samba is credited to have brought the Magis to worship the Surya in the form of an image. No mention of Magi priests are found in this myth as it is elaborated in the Bhavishya Purana and Samba Upa Purana.

Besides, the shrines of Sambaditya there are some other Sun temples also which are mentioned in Prabhasa Kshetra Mahatmya. Each temple has an exciting myth or a legend attached to it. The shrines mentioned are:

1. Gopiaditya
2. Sagaraditya
3. Chitraditya
4. Durvasaditya
5. Pingaladitya
6. Sankaraditya
7. Nandaditya
8. Parbaditya
9. Surya Prachi
10. Chyavanarka
11. Balarka
12. Baladitya
13. Naradaditya
14. Appara Narayana
15. Bakulaswami
16. Kshemaditya
17. Durgaditya
18. Karakotarka
19. Bhadrakali Balarka
20. Uttararka
21. Nagaraditya

As seen above, recorded in this great volume of the Skanda Purana, there were many temples dedicated to the Sun. To correlate the temples given here in the Prabhasa Khanda of Skanda Purana could be a separate study in itself. But it could be said that since this place was religiously honoured, it invited rage of the many of the invaders, who would have destroyed the temples. If the ruling kings had not renovated those structures some might have been lost in time.

Archaeological Evidences of Sun Worship in Prabhasa Kshetra

The highlight of this study is the field visit to the various Sun temples across the Prabhasa Kshetra. There are numerous temples found across the Saurashtra peninsula. The story of temple architecture dates back to 6th century CE, when the temple at Gop was constructed by the Maitraka rulers. Their reign saw the emergence of a style of architecture typical to the region, which evolved with time and the upcoming dynasties. It reached its ultimate aesthetic expression during the time of the Solanki rule in Gujarat. Their decline brought in decline in the architectural style.

The temples found in the Prabhas Kshetra range from, as early as 7th century CE till the 14th century CE, which shows the prominence of the cult in the region.

Sun Temple at Akhodar

Akhodar, a village in Junagadh district houses one of the ancient temples dedicated to the Sun (fig. 19). A pre-Solanki sandhara structure,

with a simple ground plan of a mandapa has six ruchaka pillars dividing to form the aisle and the nave. The garbhagriha has a small entrance, with the navagraha panel on the lintel.


fig. 19. Akhodar: Sun temple

The elevation of the temple is also simple, with plain walls. An archaic sikhara is found over the garbhagriha. The central bhadra shows successive chaitya motifs going smaller in size as it reaches the topmost tier. Finally there is an amalasaraka and a stupi.

Sun Temple at Sutrapada

Sutrapada, a village near Prabhasa Patan in Junagadh district houses a Sun temple (fig. 20). It is a sandhara structure with an oblong mandapa and the garbhagriha with the pillar dividing the hall into a nave and an aisle.


fig. 20. Sutrapada: Sun temple

The walls of the mandapa and the garbhagriha are plain except for the ventilation windows in pradakshinapatha.

The mandapa has a surpaskandha and a phamsakara super structure but uncarved. The shikhara over the garbhagriha is carved with chandrasalas in the central bhadra and amalasaraka in the karna placed alternatively with chandrasalas. There is amalaka and a stupi on top. This shikhara does not have the classic curvature of a rekha sikhara.

Sun Temple at Prasnavada

The sun temple in village Prasnavada (fig. 21) has a ground plan similar to the above two temples. In elevation also it is plain. The sikhara over the garbhagriha is carved with


fig. 21. Prasnavada: Sun temple

chandrasalas in the bhadra and has a pyramidal roof rising in receding tiers, the Phamsana. The structure has been renovated but the main sikhara retains its ancient features. There are spires added to the roof over mandapa.

In front of the temple there is a curious little structure with the images of Surya on all its four sides. According to Dhaky and Nanavati (1969), this little structure must have been a sun dial but author believes that it could be used as a fire altar.

Gayatri Temple at Prasnavada

In the same village there is a Gayatri temple originally dedicated to Surya (fig. 22). The eroded Navagraha panel could be regarded as



fig. 22. Prasnavada: Gayatri temple

the only evidence. The temple has a similar plan like the earlier ones with an addition of a rangamandapa in later times.

It is built on high plinth and is punctuated by a deep niche with a roll cornice. The walls are plain except for the ventilation windows. The Phamsana roof with chandrasalas over the ambulatory continues also over the gudhamandapa. The garbhagriha is crowned by a plain nagara sikhara.

The most important thing about this is that the circular karotaka ceiling of the gudhamandapa is supported on eight faceted pilasters, an octagonal feature. In the centre is the padmasila an earlier feature of the Solanki period.

Sun Temple at Bhimdeval

Bhimdeval, a small village near Prachi Tirtha has a temple of larger dimensions than the ones mentioned so far but similar on the ground plan (fig. 23).



fig. 23. Bhimdeval: Sun temple

The narrow entrance leads one into a large gudha mandapa. The sanctum has a small opening and is flanked by the carved images of Samjna and Nikshubha on the either side. There are no other carvings except for this.

This temple looks imposing from the exterior. As if an effort been made in balancing the heaviness by creating projections on the walls of the mandapa and garbhagriha as also by inserting windows into the mandapa and the grill into the pradakshinapatha.

The temple with its elaborate sikhara befitting its loftiness acts as a threshold to the upcoming glorious phase of temple architecture. This is a multi andaka sikhara. The shringas are prominently carved out. The two shringas present in the karna, both the sides respectively, the pratirathas also include minor shringas on the sides and the bhadra ratha including urah shringas, one above the other and finally into the main sikhara. In total, the andakas on each side would measure eleven. If the same viewed on all the three sides makes the total of 33 andakas. The front side of the sikhara does not possess the andakas as the prominent sukanasa used to be there.

Temple at Umba

The temple at Umba near Somnath Patan no longer stands on this site but there are remains strewn all over, which suggests that there once existed a large temple dedicated to the Sun with subsidiary shrines around it. One such shrine dedicated to Shiva stands here.

Sun Temple at Somnath Patan

The Sun temple in Somnath Patan (fig. 24) at the confluence of Saraswati, Hiranya and Kapila is a Sandhara temple.



fig. 24. Somnath Patan: Sikhara of Sun temple

The walls of the mandapa and a garbhagriha have fewer carvings in the horizontal layers set traditionally. While the sikhara on the garbhagriha has the carvings, which ideally should have been the part of the jangha layer of the mandovara. It shows the standing image of Surya with the udgama to top it and the other subsidiary images.

This arrangement depicts the later style of Solanki temple architecture. It represents the degenerating phase after the great Maru Gurjara style of architecture. There are small and big shringas arranged all over the sikhara which is making it look unnecessarily heavy and stunted.

Sun Temple on the Bank of River Hiranya, Prabhasa Patan

The Sun temple (fig. 25) on the bank of River Hiranya situated besides the Nagara mound is the only west facing temple that the author have come across so far in the region of Saurashtra



fig. 25. Prabhasa Patan: Sun temple on the bank of river Hiranya

and Kutch. It has an elaborate plan of shringar chowki, gudhamandapa, antarala, garbhagriha and pradakshinapatha around it. The elevation of this temple has a very interesting play of light and shade created by the numerous projections.

The shringar chowki has kakshasana like projections, with pillars and a carved entrance door to the gudhamandapa. The entrance door has a Navagraha panel on top. The pillars and pilasters are arranged to form an octagon in the centre, which support the roof. The carved concentric circles supported the sikhara of the mandapa, which no longer survives.

The entrance door to the garbhagriha is simple and has a Navagraha panel on top. The outside walls of the garbhagriha have different layers with the standing image of Surya at the cardinal points on the jangha layer. The layers here depict the layers of Mandovara.

The exterior of the temple have least of the carvings but the vertical and the horizontal projections are boldly set to create the play of light and shade. The sikhara is elaborate with many shringas and a balcony like projections on the bhadra on three sides each and on two sides of mandapa.

Conclusions

The temples in this region belong to the different time periods. Here one could see the evolution of the temple style from the earliest to the latest of the temple styles. This shows the importance of the Sun worship in this region. The tradition of the Skanda Purana runs true here with the mention of many temples in the Prabhasa Kshetra, adhering to it are the archaeological evidences. The temples at Akhodar, Sutrapada and Prashnavada belong to the Maitraka times and are of the unique style, which is austere and ornamented only on the sikhara, belonging to the early phase or the beginning of the temple architecture. It clearly shows the experimentation of the Sthapati who had not grappled with all the problems of the temple building. In comparison to these the Sun temple at Bhimdeval shows the evolution of the building style with a developed sikhara with the shringas and uruh shringas as it is build later than the Maitraka temples in around 9th century CE. The temple at Umba, though is not present but it could be estimated looking at the beautiful composition of the Siva temple one of the minor shrines to a much larger temple in all probability dedicated to the Sun.

To increase the significance of the larger shrine a deliberate attempt has been made to do away with some of the horizontal layers in its ascent. Though in a ruined state this is a very ornate temple, well-proportioned and balanced. This would belong to the 13th century CE. The Sun temple at Somnath Patan, near the Triveni Sangam is the example of the late 14th century CE temple, wherein it is not as elaborate as the temple at Umba. It does not even have the classical features of the Solanki period. As compared to the walls of the mandapa and the garbhagriha, the sikhara is elaborate in ornamentation. It looks overdone and thus looks stunted. It was the style of those times to have the sikhara ornamental with the layers that used to decorate the horizontal layers of the mandovara that decorate the sikhara. The most unique thing here is the standing image of the Sun with the udgama. Such projections in the sikhara evolved to fit in more than one storey in the temple. The temple on the bank of River Hiranya is the most interesting of the temples. Though ruined, still has the aura of a very holy place. Though outwardly it is plain with no images or carvings, yet it looks splendid with the play of light and shade due to its bold vertical and horizontal layers. It is a Sun temple and one of its kinds which is west facing. It is an elaborate temple with deep set layers, extensive ground plan and a unique feature of having Surya images set into the niches of the outer wall of the garbhagriha in the pradakshinapatha. This temple also could be dated to 14th century CE. This temple stands in a place named colloquially as the Nagara-no-timbo (Nagara's mound) and in all probability could relate to the temple of Nagaraditya as mentioned in the Prabhasa Khanda.

These temples are a testimony of the splendid Prabhasa Kshetra that was the centre of the Saura cult. These are the strong archaeological evidences supporting the tradition mentioned in the Prabhasa Kshetra Mahatmya of the Skanda Purana.

References

Bhatt, G.P. (tr.) (ed.) (2003a), 65, ***The Skanda Purana,*** part IX, vol. 67, Motilal Banarasidass Publishers Pvt. Ltd, New Delhi.

Bhatt, G.P. (tr.) (ed.) (2003b), 67, ***The Skanda Purana,*** part IX, vol. 67, Motilal Banarasidass Publishers Pvt. Ltd, New Delhi.

Bhatt, G.P. (tr.) (ed.) (2003c), 28, ***The Skanda Purana,*** part IX, vol. 67, Motilal Banarasidass Publishers Pvt. Ltd, New Delhi.

Bhatt, G.P. (tr.) (ed.) (2003d), 668, ***The Skanda Purana,*** part XX, vol. 68, Motilal Banarasidass Publishers Pvt. Ltd, New Delhi.

Bhatt, G.P. (tr.) (ed.) (2003e), 704, ***The Skanda Purana***, part XX, vol. 68, Motilal Banarasidass Publishers Pvt. Ltd, New Delhi.

Dhaky, M. and Nanavati, J. (1969) ***The Maitraka and the Saidhava Temples,*** Ascona, Switzerland.

Further Reading

Banerjea, J.N. (2002) ***The Development of Hindu Iconography,*** Fifth edition, Munshiram Mahoharlal Publishers, New Delhi,

Charak, K.S. (2007) ***Surya the Sun God,*** 2nd edition, Uma Publishers, Delhi.

Debroy, Bibek and Dipali (1994) ***The Puranas - Bhavishya Purana,*** vol. 2, Delhi.

Desai, Shambhu Prasad (1965) ***Prabhas ane Somnath*** (in Gujarati), Published by Narendra Trivedi, Prabhas Patan, Ahmedabad.

Kalyan (1992) ***SamskshiptBhavisyapuranank*** (translated in Hindi), Gita Press, Gorakhpur.

Krishna, Deva (1969) ***Temples of North India,*** National Book Trust, New Delhi,

Majumdar, R.C. (ed.) (1988) ***The Classical Age,*** vol. III, Bharatiya Vidya Bhavan, Mumbai,

Majumdar, R.C. (ed.) (1989) ***The Struggle for Empire,*** vol. V, Bharatiya Vidya Bhavan, Mumbai,

Majumdar, R.C. (ed.) (1993) ***The Age of Imperial Kanauj,*** vol. IV, Bharatiya Vidya Bhavan, Mumbai,

Monier, Williams (2001) ***Indian Wisdom***, Rupa and Co., New Delhi.

Pandya, Kanan (2001) ***Sun worship in Saurashtra and Kutch***, an unpublished thesis, Department of Ancient Indian History, Culture and Archaeology, The Maharaja Sayajirao University of Baroda, Vadodara.

Pargiter, F.E. (1922) ***Ancient Indian Historical Tradition,*** Oxford University Press, London.

Sir Bhagvatsinhji (1986) ***Bhagvadgomandal*** (Gujarati Encyclopaedia), pt. 9, 2nd edition, Pravin Prakashan, Rajkot.

Notes

[1]SkP - Skanda Purana

[2]Pkm - Prabhasa Kshetra Mahatmya

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Conservation of Cultural Heritage



Challenges of Science and Technology in Solving Problems Connected with Conservation of Paintings:

Experiences and Requirement of Archaeological Survey of India

Manager Rajdeo Singh and B.R. Arbad

Introduction

India has a long coastline where climatic conditions vary from mild and bracing to hot and humid. The deserts on the other hand are very hot. In this region, the works of art react in different manner from those in coastal regions. The low relative humidity of dry climate causes desiccation of oils, varnish and glue adhesive. Paint films become hard, brittle and age in a short time. Through photo-chemical effects, canvasses particularly with high lignin content lose their strength rapidly. It also provides a highly nutritive host for mould growth. If a paint film appears to be glue distemper or pure egg-tempera, the contraction and expansion of cotton duck in tropical conditions is highly disastrous. Water colour drawings and documents become brown and yellowed by oxidation and show little resistance to tear.

In archaeological studies, chemical composition of painted material, pigments and binding medium, etc. form the central part of investigation for extracting more information about the paintings. Nearly all the binding media which have been used in paintings fall chemically into three groups - 1. Protein (egg and glue), 2. Oil, 3. Resin. Whereas, the compositions of binding media of western paintings have been well understood (Xingguo et al. 2005), the binding medium of Indian paintings have not been fully investigated till date. As compared to pigment analysis, the problem of analysis of binding medium is difficult mainly because-

1. The proportion of medium in a given sample is much smaller than the proportion of pigment;

2. The physical and chemical changes which the binding media undergoes with time.

Until the introduction of oil as a universal binding media during the fifteenth century, the materials most frequently used as media were glue and egg-tempera. Because of the physical and chemical changes which take place with time, aged proteins and oils cannot be identified as such by chromatographic techniques. It must be first broken down into more easily recognised substances.

Protein, which is a very large and complex molecule, is built up from amino acids. The amino acids may be ranging in size from small and simple molecules to very large and complicated molecules. Acid hydrolysis breaks the protein to its constituent amino acids (Singh and Trambake 2006). A large number of amino acids are common to all the proteins. But there is an important difference between the amino acids of glue and egg which is of great importance to archaeological chemist for extracting more information about the paintings. Glue contains all the usual amino acids including the one called hydroxyl proline where as egg does not contain this particular amino acid. Thus, there is possibility to distinguish the two types of proteins. The reagent which is used for locating amino acids on the chromatograms is a solution of triketohydrindene hydrate (ninhydrin) which reacts with all amino acids, except proline and hydroxyl proline, to give

pinkish blue spots on a white background. With proline and hydroxyl proline yellow spots are obtained. The chromatogram obtained from samples of unknown media has to be compared with standard solutions, prepared under similar conditions. The two standards mostly used for this purpose are egg-tempera and rabbit skin glue.

The oils used in paintings are drying oil extracted from plant seeds. These are compounds of glycerol and fatty acids. When exposed to air in thin layers, the oils have property of forming clear films those are hard and insoluble. In this, oxygen from the air joins the molecules of the oil to form a closely linked structure. By the process of acid hydrolysis, glycerol part of the oil can be released from its original structure and determined chromatographically and the results can be compared with a standard solution of glycerol. Hence, the binding media analysis is nothing but an unsolved problem and with proper co-ordination of different research laboratories; the media can be very well analysed. Moreover, the results of such chemical analysis will be of greater significance both from historical and conservation point of view of the paintings. With the use of Electron Probe Microanalyser not only the mixed pigments of the paintings can be identified up to very low level but also the individual pigment grains can be differentiated from one another. When several layers of paints are present, the different chemical composition can be identified since the thickness of a layer of paint is large compared with the resolution of the instrument? In-situ x-ray fluorescent analysis seems to be an avenue for research which will yield very useful result in the analysis of paintings. By suitable optical system incorporating with a low power microscope, one could arrange things in such a way that the precise point of analysis can be determined without removing any sample of paint.

Cotton duck is composed of pure cellulose having poor resistance to tropical hazards. Its main virtue is its resistance to the photo-chemical effects of light. Compared to bast fiber, its reaction to high relative humidity and sudden climatic change can be described as violent. It also provides a highly nutritive host for mould growth. On the other hand, canvas consisting of jute, sisal or ramie fibers highly incrusted with lignin is much more resistant to mould growth. However, if not properly sized they are more easily rotted by linseed oil paint fiber.

Mould growth will flourish vigorously on oil, tempera and casein paints. It is rarely found in good quality water colour paints. The tacky layer of unpigmented oil will inevitably attract mould spores and provide nourishment necessary for their growth. Generally speaking the richer the paint film in the medium, the higher the incidence of infection. Most of the common pigments are inert to mould growth i.e. they neither encourage nor inhibit fungal activity. Zinc oxide is usually classed as inhibitor. Titanium and white lead are also inert. Alizarin and carbon blacks are also susceptible to mould growth. Increased pigmentation reduces infection, particularly when calcium carbonate is used as an extender. Calcium carbonate is not directly toxic but imparts a high degree of alkalinity to the paint film, an adverse condition for mould growth. When linseed oil film is attracted by mould growth it becomes spongy, less elastic, more soluble to alkalis and more easily swollen by water. Mould infection can be controlled by constant vigilance, regular inspection and the use of fungicides. Surface infection is treated by applying fungicide solution to the mould colonies with a small and soft brush. This is usually effective in early stages of mould growth, but once the mycelium has become deeply imbedded, it is relatively useless. In European countries staining caused by the secretion of the micro-organism and deep rooted mycelium has been removed using high speed rotary dental burrs whilst working under the binocular microscope. However, this is a very drastic treatment which requires a great deal of skill and patience.

Paint films which are not varnished are highly susceptible to mould growth. The function of varnish coating is to offer physical protection to the underlying material and also to improve the appearance of the coloured pigments by colour saturation. Varnish coating is applied in the range of 1-50 microns thickness depending on the surface condition of the paintings, degree of absorption of paint medium, etc. Since the varnish coatings are impermanent, both in physical and chemical sense, it becomes essential to remove them wholly or partially from the painted surface at intervals ranging from a decade to a generation or more depending on the environmental conditions. The degradation of varnish film is reflected by change in their visual properties and to chemist though analysis which may be recorded in a graph by an IR spectrophotometer.

There is a danger in applying the so called active solvents in the removal of varnish. If solvents are to be used for removing old varnish films, chemicals must be found which have a low swelling action on oil films, low degree of diffusion and at the same time are efficient in softening of varnish coatings. If the colloidal chemistry of the paint is understood properly then it should be possible to select the best solvents and effective procedure for safe cleaning. This is another area where the works done on the colloidal chemistry of Indian paintings are very scare.

Discussions

Attempts of chemists working in Archaeological Survey of India (ASI), for the removal of coating indicate that a single solvent like toluene, acetone or ethanol used alone was either totally ineffective or much less effective in improving the ease of solubility of the coatings. For removal of coatings, the possibilities of mixture of solvents have proved very effective (Walter 2007; Singh and Arbad 2013: 161-176). It will be worth mentioning to record the investigation done in this direction for the benefit of conservators. Figure 26 shows a panel painting with the shellac varnish at Ajanta.



fig. 26. Cave no. 19, Ajanta: Shellac varnish on ceiling painting

For the preservation of murals, a sound knowledge of artistic materials and techniques is the first pre-requisite. The object of the cleaning is to reveal all the artistic details without affecting the pigments and paint layer. It is the knowledge of the chemistry of colours, their action and interactions and an understanding of the effect of solvents on the paintings which endows the scientific restorers and conservators of paintings with the ability to clean and conserve the murals without any loss of details and what is at most importance is without altering the optical appearance of the paintings.

When the chemical branch of ASI started their work in 1954 at Ajanta, one of the first tasks was to remove the shellac coat which has turned yellow or even dark brown. On the basis of long drawn experimentation a useful mixture found suitable was -

Acetone - 1 part;
Diacetone alcohol - 4 parts;
Amyl acetate - 1 part;
Cellosolve - 4 parts;
Morpholine - few drops.
(Turpentine/ petroleum spirit was used as restrainer)

Initially, during chemical cleaning when the solvents were applied, the coating on the surface was removed and the paint layer seems

to have regained its original look. However, in a few days whitish deposit called chalkiness appeared on the cleaned surface. Figure 27 shows after and before treatment photograph of such points. The conservators had to face


fig. 27. Cave no. 17, Ajanta: Chalkiness on paintings and its removal

a lot of criticism after the appearance of chalkiness as loss of pigment was feared. It was a great challenge to the chemist to explain the appearance of chalkiness on the cleaned surface and hence examination of paint sample under cross-section was felt necessary. M.S. Mathur, a chemist from ASI, carried out extensive study both in conservation laboratory at Belgium and ASI laboratory at Dehradun (India) by using Hylak resin (Mathur 1968: 10-14). This method proved a great help not only in determining the stratigraphy of the painted layer but also the structure of the paint films. It is particularly suitable for determining the technique of painting process adopted in the execution of various murals. How the surface accretions affect the painted surface and cause defects in the paint film can also be ascertained under such examination. Once the behaviour of surface accretions is accurately known, the clinical treatment of the paintings can be carried out with confidence. After examination of the polyester resin, the pigment at Ajanta was found intact and chalkiness was found to be only a superficial deposit. It was elucidated that whiteness is because of broken down particles of shellac, which is no longer a cohesive film transmitting light and it was slowly removed from the surface.

Some of the caves at Ajanta were under worship and the monks use to burn incense sticks especially in cave no. 17 and 6 (Cartechini 2010: 867-876). The smoke coming out from these was deposited on inner painted surface. On some places of Ajanta paintings, it was noticed that Italian conservators of 1920 have applied shellac varnish on the painted surface having soot deposit. Scientific cleaning of such part is very complicated as the solvents used for cleaning may also have impact on black outlines of the figures (Singh 2011: 89-94). With extraordinary dexterity and care many paintings at Ajanta have been cleaned for sooty accretions. Figure 28 shows a part in cave no. 17's Pilaster, Ajanta cleaned for the removal of soot from the painting.


fig. 28. Cave no. 17, Ajanta: Removal of soot from pilaster

However, there are many unsolved problems that need solutions. Before the discovery of Ajanta in 1819, thousand of bats were nesting inside the caves. Many of the paintings, plasters and stone surface have thick deposits of bats excreta and urine. Being hydroscopic in nature, it spreads and contaminates the surrounding plaster of the painted surface slowly, especially in rainy seasons. Figure 29 here shows part of a painted pillar infested with bat excreta.


fig. 29. Ajanta: Pillar brackets infested with bat excreta

Methodology to remove bat excreta from the painted plaster are yet to be explored at Ajanta and elsewhere in order to save the precious murals for posterity.

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References

Cartechini, L., Vagnini, M., Palmieri, M., Pitzurra, L., Mello, T., Mazurek, J. and Chiari, G. (2010) Immunodetection of Proteins in Ancient Paint Media, ***Accounts of Chemical Research***, 43 (6).

Mathur, M.S. (1968) Cross sectioned studies of Indian Mural paintings – A New Approach, Conservation of Cultural Properties in India, ***Proceedings of 3rd National Seminar***, vol. 1-5.

Singh, M, (2011) Microclimatic Condition in Relation to Conservation of Cave No. 2 Murals of Ajanta, ***Current Science***, 101(1).

Singh, M. and Arbad, B.R. (2013) Chemistry and Preservation of Ajanta Murals, ***International Journal of Conservation Science***, 4(2).

Singh, M. and Trambake, R.S. (2006) Scientific conservation of Ajanta Cave Paintings and Sculptures, ***National Conference on Ajanta Caves - A critical Appraisal***, Mumbai University, Mumbai.

Walter, M. Spink (2007) ***Ajanta History and Development,*** vol. 5, Leiden, Boston.

Xingguo, C., Yuquan, F., Tetuo, S., Zhide, Hu, Zuixiong, Li (2005) A study on the Proteinous Binding Media in Tibetan Murals with Reversed Phase High-Performance Liquid Chromatography, ***Canadian Journal of Analytical Sciences and Spectroscopy***, 50 (6).

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Deteriorative Effect of Micro-organisms on Stone Surface of Historical Buildings and Monuments with Special Reference to Fungi

Sanjay Prasad Gupta

Introduction

Numerous factors affect the stone durability as stone surfaces are continuously exposed to physical, chemical and biological degradation. Physical, Chemical, and biological agents act in co-association, ranging from synergistic to antagonistic, to the deterioration. Among biological agents micro-organisms have critical importance in stone deterioration. They can cause various damages on the stone surface, such as, formation of boil, chemical reactions with substrate, physical penetration into the substrate and pigments production. Numerous studies are being done which deals with establishing the role of biological agents in the stone deterioration (Pochon and Jaton 1968: 258-268; May et al. 1993: 109-123). During recent decades there has been a general concern about the deterioration of historic buildings. Along with chemical and physical factors, microbial growth plays an important role in this process (Suihko et al. 2007: 494-508). Microbial colonisation of stones depends on environmental factors such as water availability, pH, climatic exposure, nutrient sources, and petrologic 245 parameters such as mineral composition, type of cement, as well as porosity and permeability of rock material (Warscheid and Braams 2000: 343-368). The stone ecosystem is subject to harsh environmental changes, especially temperature and moisture, exerting extreme selective pressure on any developing microbial community (May 2003). Bio-receptivity of stone depends on its structure and chemical composition, while the intensity of microbial contamination is determined by the climatic conditions and anthropogenic eutrophication of the atmosphere (Prito and Silva 2005: 206-215). Biofilm formation on clean surfaces usually starts with phototrophic organisms (algae, cyanobacteria), which use CO2 from the atmosphere as their carbon source and sunlight as their energy source. Heterotrophic organisms (most bacteria and all fungi) need some organic source for their growth, which is provided by metabolites of phototrophic organisms or by air-borne deposition. It has been shown that very low nutrient requirements of some rock inhabiting heterotrophic micro-organisms may be fulfilled by remains of polluted air and rain or animal remains and secretion (Suihko et al. 2007: 494-508).

Biological growths such as algae, bacteria, fungi, lichens and mosses are common on the exterior of buildings especially in rural areas (fig. 30 a to g as on page 42). They will build colonies over exposed stonework wherever conditions of moisture, light, temperature and nutrition are suitable. Dark soiling on a surface is often equated with particulate soiling when closer inspection would reveal soiling of a biological nature. The issue of biological growth on buildings is to a large extent a matter of perception and aesthetics. It is important to bear in mind that their presence on stone is not necessarily harmful and depending on circumstances, it may not be necessary to



fig. 30 a to g. Growth of biological agencies on the exterior surface of monuments: a.-Bhim ki chak temple,Mlhar, Chhattisgarh b.-Mahadev temple, Bastar, Chhattisgarh c.- Mahadev temple, Narayanpur, Chhattisgarh d.- Chandraditya temple, Barsoor, Chhattisgarh e.- Sita Devi temple, Deorbija, Chhattisgarh f.-Mama Bhanja temple, Barsoor, Chhattisgarh g.- Laheripura gate, Vadodara, Gujarat

remove them. In the past, growths, in particular lichens have sometimes been encouraged on buildings by a number of methods including applying a wash of cow dung and water, urine of human or skimmed milk. A patchwork of differently coloured lichens over a stone surface may be considered aesthetically pleasing and indicate a relatively clean atmosphere.

Material and Methods

Deterioration Process

Damage to stone is caused or initiated by the presence of biological growths. In some cases, a biological growth may act as a protective layer shielding the stone from other factors those can cause decay, such as wind and rainwater. Biological growth is only one of many environmental factors that may contribute to the deterioration of stone, and its removal will not necessarily halt the process of erosion (Kharbade and Bhatia 2003). Where control of growths on the surface of stone is considered necessary for reasons of safety, decay or aesthetics, it can often be achieved simply though the control of surface wetness by repairing or improving drainage, or encouraging quicker dry-out by reducing the sheltering effects of closely situated vegetation or other structures. Several species of fungi have been isolated from weathered stones being inorganic, does not by itself favour the growth of fungi. The presence of organic residues on stone, however, encourages their growth. The biochemical action of fungi on stone appears to be a more important process than mechanical degradation. Fungi are believed to be potential contributors to decay of limestone, silicate minerals (mica and orthoclase), and iron-and-magnesium bearing minerals (biotite, olivine, pyroxene), but the extent of total decay attributed solely to them is undetermined. The acids produced by various species of fungi function as chelating agents that can leach metallic actions, such as calcium, iron, or magnesium, from the stone surface. Oxalic acid can cause extensive corrosion of primary minerals and the complete dissolution of ferruginous minerals through the formation of iron oxalates and silica gels. Laboratory experiments have demonstrated that basic rocks are more susceptible to fungal attack than acidic rocks. It has also been shown in the laboratory that fungal species such as Aspergillus niger were able to solubilise powdered stone and chelate various minerals in a rich glucose medium because they produce organic acids such as gluconic, citric, and oxalic acids. Similar experiments involving stone have demonstrated the formation of oxalate crystals, which adhered to lichen and fungal hyphae or were deposited nearby.

Preventive and Remedial Methods

Cleaning of Stone Surfaces

Partially removing biological growth before applying biocidal agents is usually recommended, particularly where stone structures become encrusted with thick cushions of mosses, heavy lichen, and algae growth over a protracted period of time. This procedure hastens biocidal activity by allowing better penetration. Traditionally, conservators have favoured mechanical methods for removing biological growth, as they eliminate the danger of leaving behind unwanted substances on the stone. These methods involve physical removal of biological material by hand or using tools such as stiff bristle or nonferrous soft-wire brushes, scalpels, spatulas, scrapers, sickles, pick axes, or hoes. For trees and creepers that attach themselves to the surface of monuments with suckers and tendrils, it may be necessary to cut the length of the main stem at a convenient

height above ground level. The plant may then be left in this state to die of its own accord, or a toxic material may be applied to hasten its destruction. The literature is full of references to such measures as part of overall conservation efforts to restore stone monuments and sites. Although frequently used, these methods have not produced long-lasting results, as removal of superficial mycelium or cutting of vegetation alone does not completely arrest vegetative activity of these organisms. Algae may redevelop from airborne spores, lichen hyphae remaining within the stone may produce a new thallus, and plants may respire out rather rapidly when suitable environmental conditions exist. To completely eradicate biological growth, the operation must be repeated from time to time. Moreover, there is always the danger that such methods may damage a stone surface. Micro-organisms associated with the visual disfigurement of monuments can be gently removed mechanically by dry or wet scrubbing or brushing, and washing with water. Brushing and washing with water have been found effective for some algae, spermatophytes, and pteridophytes but mostly ineffective for mosses and crustose lichens. Mosses and lichens may be more easily removed by low-pressure washing and/ or after the application of certain chemicals. Steam cleaning may also be useful in killing mold and algae on damp surfaces.

However, it must be remembered that water introduced during cleaning processes may actually encourage rapid algae re-growth (May et al. 1993). Hence, the effectiveness of all cleaning methods involving large quantities of water must be carefully assessed in relation to microbial loading, as it has been found that such treatments reduce the amount of infestation only for a relatively short time. This problem may be avoided by applying a biocidal treatment after cleaning. Prior application of dilute ammonia has often been recommended to facilitate the mechanical removal of lichens on stone, as it assists in the swelling and softening of the thalli. 2-5% aqueous ammonia (Agrawal 1993) with 2-3% non-ionic detergent (neutral) has been found to be very effective in cleaning the stone monuments in India that were covered with mosses, lichens, algae, and fungi without creating any side effects. This cleaning is usually followed by a biocidal treatment to inhibit biological growth and a water-repellent or preservative treatment to act as a water barrier.

Biocidal Treatment

Biocides refer collectively to bactericides, fungicides, algicides, and herbicides. They are frequently used to eliminate and inhibit biological growth. Biocides may inhibit the metabolic activity of target organisms, thereby causing irreparable damage and even death. Application of aqueous solutions of sodium hypochlorite (13%), and formaldehyde (5%), using soaked cotton strips for about 16 hours, followed by scrubbing with a brush and water, effectively killed lichens on stone. A quaternary ammonium compound (Hyamine 3500) applied on sandstone monuments after chemical cleaning has effectively inhibited microbial growth. However, this treatment is known to provide only temporary inhibition, suggesting that periodic treatment is required to prevent reinfestation, particularly in tropical environments, where environmental conditions promote rapid biological growth. Sodium pentachlorophenate (2%) was not found to be very effective in field trials. It could prevent microbial growth only for six to twelve months. Besides, these treatments are toxic and may stain light-coloured stone by reacting with the iron of the stone surface. Copper sulphate, which is frequently used as a biocide, is much more effective against algae and fungi than bacteria.

Biocide Application: Procedures and Precautions

Biocides may be washed out by rain before they have had time to act. Biocidal treatments should therefore be undertaken during dry conditions. Windy weather may lead to excessive drift of biocidal spray and pose health and environmental hazards. When handling and mixing biocides, one must remember to always wear rubber gloves, safety glasses, and a respirator. Only the required quantities of diluted biocides should be prepared, as their effectiveness may be reduced when they are stored for a long time. Depending on the state of conservation of the stone, the organisms to be eliminated, the density and diffusion of biological attack and product chosen, treatments may be carried out by spraying, brushing, applying poultices, or injection. Worldwide spraying and brushing of diluted biocidal solutions appear to be the most common modes of application. Brushing is recommended when the stone surface is in fairly good condition and the area required to be treated is relatively small. Spraying is the preferred choice for deteriorated stone surfaces. Diluted biocidal solutions may be applied with a pneumatic garden-type sprayer with adjustable nozzles, preferably two-thirds full of the diluted biocides. Biocides are applied in sufficient quantities to wet the top and sides of the stumps. In cases where two biocides have been used to completely eradicate biological growth, the area treated after one biocide application is left for at least one week to affect the initial kill. The dead biological growth can then be brushed off with bristle brushes. With more persistent biological activity, a second biocide may be applied according to manufacturer's specification to inhibit biological growth successfully (Garg, Dhawan, and Agrawal 1988).

Some Considerations in Biocide Selection

While the term biocide pertains to any chemical able to kill or inhibit the growth of living organisms, it is most commonly used with regard to micro-organisms and higher plants. These chemicals, however, are also potentially harmful to wildlife and humans. For this reason, there is a mandatory need to identify and disclose the toxicological properties of biocides and to perform a risk assessment for each specific biocide application. When considering biocides for controlling and eradicating biological growth on stone monuments, several factors, such as efficiency against target organisms, resistance of target organisms, toxicity to humans, risks of environmental pollution, compatibility with stone, and effects of interactions with other chemical conservation treatments, need to be discussed. The first step in choosing a biocide for stone should be to identify the biodeteriorating agents as accurately as possible. Often biocides tend to be more efficient on some organisms than others. Efficiency depends on the type of biocide and the conditions under which it is applied. Parameters such as temperature, rainfall, pH, relationship between concentration and activity, and contaminants, which determine the effectiveness of a biocide, must be carefully considered. At present, there are few compounds that are equally efficient in eradicating all types of biodeteriogens. Although a residual biocide with persistence activity is advantageous with regard to long-term inhibition of biological growth, it may be a potential public health and environmental hazard.

Resistance of Target Organisms

Resistance is the natural or genetic ability of an organism to tolerate the toxicity of chemicals which is a very important consideration in the effective use of biocides. Some organisms,

especially bacteria, can develop resistance to a particular biocide over a period of time. It then becomes necessary to apply a different biocide, which may prove more effective against growth. This biocide must be compatible with the previously applied biocide, and this can be assessed only experimentally. Identification of micro-organisms is important in making the choice of the subsequent biocide. Rotation of biocidal products may help avoid the development of resistant strains of micro-organisms (Caneva, Nugari, and Salvadori 1998: 182-234).

Toxicity to Humans

Before using a biocide on stone surfaces, one should be aware of not only its toxicity to biological growth but also its toxicity to humans. Such information can be obtained from the manufacturer, appropriate government regulatory agencies, or toxicology sourcebooks. In United States, this information is provided on the Materials Safety Data Sheets obtainable from the manufacturer. The literature describes several parameters that define the toxicity of a compound. The most common indices for quantifying toxicity are LD50 and LC50 values. LD50 is an abbreviation for Lethal Dose 50% and is the most common measure of acute or short term, single exposure toxicity for a particular substance. It is essentially the amount of active substance that can be expected to cause death in half (50%) of a group of a particular experimental animal species, such as rats or rabbits, when entering their bodies orally or through dermal exposure (e.g., sodium pentachlorophenate oral LD50r = 180 mg kg +1, where r = rat). The amount required to kill individual animals is related to their body weight. Therefore, LD50 figures are usually reported as units of milligrams of the substance per kilogram body weight of the animal species concerned. LC50 (Lethal Concentration 50%) is a similar and a widely used measure of chronic toxicity or long-term exposure to a gaseous substance through inhalation over a specified period of time. LC50 figures are usually reported as milligrams of a substance per cubic meter of the atmosphere to which the animal is exposed over a particular time period. From the foregoing, it is clear that the higher the LD50 or LC50 value, the lower the toxicity of the substance. However, it requires expert judgment to assess the relevance of toxicity data derived from animals to humans. Ideally, biocides used in the field of stone conservation should have high LD50 or LC50 values.

Risks of Environmental Pollution

As a result of an increasing interest in the conservation of the environment, apprehension regarding the risks of environmental pollution from the use of biocides has grown. Considerable information on this subject can be found in the literature, particularly in the fields of agriculture, ecology, hydrology, health, and environmental science. The risks from biocides are linked to factors such as drift and undesirable effects on non target micro flora, plant, animal, and aquatic life. The problem is especially relevant where the risk of contamination of soil and water is high. This is correlated with the chemistry of the soil, its moisture content, the pH, the climate; particularly wind conditions, and present flora and fauna. To protect non target species from injury and extermination due to direct or indirect exposure to these toxic substances, federal environmental protection agencies in different countries have established different standards for their use, handling, and disposal. Compatibility with stone and other conservation treatments a biocide should be compatible with the surface on which it is applied. It should not alter the nature, composition, and appearance of stone. For instance, treatments with a sodium salt of phenol suffer from the serious

disadvantage that they may cause staining in some stones through the reaction of the alkali phenol with iron in the substrate. It has also been found that the efficiency of biocides in killing target organisms is usually not the same on different stone substrates, as surface conditions and stone mineralogy often affect biocidal activity.

Water Repellent and Consolidant Treatments

Synthetic polymers and resins have been used as protective coatings and consolidants in tropical environments. Clearly, for micro-organisms on stone, such compounds need to be evaluated, particularly in tropical regions, for the ways in which they influence growth either directly or by the change in the microenvironment they create (Griffin, Indictor, and Koestler 1991: 187-208). In recent studies of preservation treatments, various protective coatings have been screened for microbial susceptibility in the laboratory before applying on stone in the field. The results of most laboratory studies indicate that some of these water repellents like silane-silaxone based preservatives and consolidants including organosilanes, silicones, (Product Manual - Sillicone Division 2002) acrylics, epoxies, and polyvinyl acetates appear to have practically no effect on the growth of microorganisms on stone and that, on the contrary, some of them could be a source of nutrients for micro-organisms. Field experience has suggested that since growth of micro-organisms is usually associated with moisture retention, certain water repellents may be used to increase the effective life of a biocidal treatment and inhibit growth on clean surfaces. These treatments work more effectively when applied to new stone or to clean stone surface that has already been treated with a biocide. For instance, it was found that applying 2% polymethyl methacrylate solution in toluene and Wacker BS-290 with MTO (1:16) to sandstone after a wet cleaning and biocidal treatment was effective in inhibiting biological growth for at least ten years on several monuments in India. It is also important to remember that water-repellent treatments should never be applied to surfaces those are suspected to get damped from inside, for example, from rising damp, as there is a danger that salt crystallisation may occur beneath the treated surface, causing it to spall.

Results and Discussions

Fungal species from sandstone cause discolouration, as well as mechanical exfoliation of building stone material that was analysed through mechanical hyphae penetration and production of different pigments and organic acids were among dominant micro fungi on the mineral substrate. Biological infections and the intensity of bio-deterioration processes are strongly influenced by water availability. This is determined by material-specific parameters, like porosity and permeability, environmental conditions of the site and exposure of the object. The establishment of fungi on rocks is possible even without the pioneering participation of phototrophic organisms. Fungi are especially concentrated in stone crusts. They are able to penetrate into the rock material by hyphen growth and bio corrosive activity, due to excretion of organic acids or by oxidation of mineral forming cations, preferably iron and manganese. Their deterioration activities also include discolouration of stone surface, due to the excretion of melanin by dematiaceus fungi. Recently, it has been apparent that fungi comprise a significant component of micro biota in a wide range of rocks including sandstone, granite, limestone, marble and gypsum. In the Earth's lithosphere, fungi are of fundamental importance as decomposer organisms, being ubiquitous in sub-aerial and sub-soil environments. The ability of fungi to

interact with minerals, metals, Metalloids and organic compounds through biomechanical and biochemical processes makes them ideally suited as biological weathering agents of rock and building stone. Biological and mycological investigations are very important part of good conservation and cannot be ignored in modern conservation concepts which include close collaboration between art and science.

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References

Agrawal, O.P. (1993) Conservation of Cultural Heritage - The Challenges Before Us, ***Journal of Indian Museum***, 49.

Caneva, G. and Salvadori, O. (1998) ***In Deterioration and Conservation of Stone*** (eds Lazzarini, L. and Piper, R.), UNESCO, Paris, No. 16.

Griffin, P.S. Indicator, N. and Koestler, R.J. (1991) The Biodeterioration of Stone: A Review of Deterioration Mechanisms, Conservation Case, Histories and Treatment, ***International Biodeterioration***, 28.

Kharbade, B.V. and Bhatia, S.K. (2003) ***Preventive Conservation of Museum Objects,*** National Research Laboratory for Conservation of Cultural property, Lucknow.

May, E., Lewis, F.J., Pereira, S., Tayler, S., Seaward, M.R.D. and Allso, P.P.D. (1993) Microbial Deterioration of Building Stone - A Review, ***Biodeterioration Abstracts***, 7.

May, E. (2003) Microbes on building stone - for good or ill?, ***Culture***, 24(5).

Pochon, J. and Jaton, C. (1968) Biological Factors in the Alteration of Stone, In: A.H. Wolters, C.C. Elphick (ed.) ***Biodeterioration of Materials,*** Elsevier, Amsterdam.

Prieto, B. and Silva, B. (2005) Estimation of Potential Bioreceptivity of Granitic Rocks from their Intrinsic Properties, ***International Biodeterioration and Biodegradation***, 56(4).

Suihko, L.M., Alakomi, L.H., Gorbushina, A.A., Fortune, I., Marquardt, Saarela, M. (2007) Characterization of Aerobic Bacterial and Fungal Microbiota on Surfaces of Historic Scottish Monuments, ***Systematic and Applied Microbiology***, 30.

Wacker - Chemie GmbH (2002) ***Sillicone Division - Product Manual,*** Germany, Munich.

Warscheid, Th. and Braams, J. (2000) Biodeterioration of Stone: A Review, ***International Biodeterioration and Biodegradation***, 46 (4).

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Conservation of Ancient Buildings:
Cement Vs. Lime

Tapan Bhattacharya

Till the advent of cement in the mid nineteenth century, lime was extensively used for construction of building structures. Repairs to these structures should be done with lime mortar not only for maintaining originality and authenticity of the buildings but also to retain the properties of the lime-built buildings by virtue of which the buildings have successfully performed for centuries.

Ancient buildings built in soft and flexible lime mortar are safe and protected against probable damages caused by minor movements of ground due to temperature changes and mild earthquakes, etc. If repaired with strong and rigid cement mortar, these buildings will loss flexibility and will easily receive cracks and major damages by ground movements.

It is often argued that cement mortar is stronger than lime mortar and therefore repairs to old buildings using cement mortar will yield better strength to the building. But traditionally constructed stone walls or brick walls do not require very strong mortar for strength and durability. Strength of repair mortar should be either same or little below the strength of principal building material i.e. stone or brick. A stronger mortar does not always give a stronger wall rather can cause damage to the historic wall by cracking (fig. 31). Pure lime mortar remains softer and is less rigid and therefore



fig. 31. Cement plaster affecting the core material

does not cause any damage to the historic masonry units.

It is often thought that an addition of little cement to lime mortar will enhance the strength of lime mortar and will strengthen the masonry. An English Heritage research project carried out recently in association with the Building Research Establishment in U.K. has revealed that, the addition of small quantities of cement to lime: sand mortars (less than a proportion of 1:3:12 of cement: lime: sand) is likely to have a detrimental effect on the strength and durability of mortar. This research project has also confirmed the fact that addition of surki (crushed brick) into lime mortar has most positive effect on the strength and durability of lime mortar.

While repairing the old buildings, some shrinkage occur in fresh mortar during hardening and fine cracks appear. Such shrinkage cracks of lime mortar do not cause any harm because they occur when the mortar is still in plastic state and mostly disappear by the self healing property of lime. But in cement rich mortars, the shrinkage occurs at a later stage and mostly leaves permanent cracks in historic wall joints.

Traditionally constructed buildings need to breathe for keeping them dry from inside by releasing moisture through exposed wall surfaces which is called surface breathing. Lime mortar is permeable and therefore can effectively allow evaporation of moisture entering into the building by capillary action, etc. If repaired with non-porous cement mortar, moisture from the inside of the walls cannot be extracted by evaporation and trapped moisture takes its toll by damaging and decaying building materials (fig. 32).



fig. 32. Cement based repairs that caused accelerated decay to the century old brick structure

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Heritage and Culture

Living Tradition of Stone Bead Manufacturing at Khambhat:
An Ethnoarchaeological Study

Hardika S. Pandya

Introduction

Ethnoarchaeology investigates aspects of contemporary socio-cultural behaviour from the archaeological prospective. Ethnoarchaeology attempts to systematically define relationship between behaviour and material culture and to ascertain how certain features of observable behaviour may be reflected in archaeological records. Tringham defines ethnoarchaeology as "The structure of series of observation on behavioral pattern of living societies designed to answer archaeologically oriented questions" (Tringham 1978: 169). Following article presents an overview of the important technological and organisational aspect of stone bead production of red-orange agate, more commonly referred as carnelian in Khambhat.

Bead-Making

Bead-making has always played an important role in human culture, both as a means of ornamentation and as well as a method of defining ones social and ritual status. Bead-making is one of the oldest specialised craft in south Asia, with roots extending back to Paleolithic and Mesolithic around 10,000 to 8,000 years BP.

The major technological development for bead-making using stones such as jasper and agate began in the Mesolithic from 7,000 to 4500 BCE and by 2500 BCE. With the aid of archaeological research, the stone bead industry in Pakistan and western India can be traced back even earlier to the cities and villages of Harappan phase of the Indus tradition, dated around 2500 BCE (Rao 1973: 78). Further this tradition was also evident in early historic to historic period and is still one of the major centers of bead-making in the world.

Khambhat (N 20° 99', E 72° 33'), a taluka town is situated at the tip of the gulf of Khambhat. Puranic traditions and legends attribute several names to Khambhat such as Mahisagar, Sangam kshetra, Gupta kshetra, and Kaumarika kshetra, Stambhatirtha, Tambavati, Bogavati and Khambhagat, etc.

The agate industry at Khambhat is one of the largest stone bead working centers of the world and it has been an important center for over 3000 years of documented history (Acharya, Vora and Trivedi 1964: 5). Since 9th century CE, one gets historical information on bead-making through literary accounts of early merchants and also in the form of material remains. The early influence to the maritime activities was made by the Arab geographer Khurdaben in his work, ***The Book of Roads and State***, written in 856 CE. The well-known Arab traveller, Al-Masudi visited Khambhat in H. 303 (1913-14 CE) and he records that Khambhat enjoyed great fame for its precious stones, which were very popular in the markets of Adan and Mecca. The present-day Khambat

was also an important port which flourished from first millennium BCE and had carried out trade activities with foreign countries like Rome.

However, in around 10th century CE during the rise of Solanki Dynasty, Khambhat became a significant international port, due to the silting of the channels leading to Bharuch (Janaki 1980: 3-4). The excavations at the town of Nagara, some 3 km north of Khambhat, have revealed that carnelian beads were being manufactured there during the 14th century (Mehta and Shah 1968: 57)

Bead-Making at Khambhat

At present, the town of Khambhat is the only remaining production center of bead-making industry where artisans are still using traditional techniques. A brief over view of the sequence of the beads production have been presented here which is as follows -

Raw Material Acquisition and its Sources

Raw materials used for bead-making are found in the rich geological deposits of Baluchistan and Gujarat. The deposits in Gujarat are found in good number particularly in the region around Bawa Ghor hill, near the village of Ratanpura, Rajpipla and Jhagdiya of District Bharuch. Apart from these, mines are also found in central India in the region around Aurangabad (Gadekar 2006: 4).

Mining in Gujarat is generally done by Bhil groups. Men, women and children are involved in digging of the mines using simple tools. The agate nodules are collected from agate conglomerate beds of the Babaguru formation that was deposited in this region during the Miocene, some 30 million years ago. These nodules are carried to the surface sorted according to their colour and quality. These are then passed to the traders who transport them to Khambhat. These acquired raw materials are then stored on open area near the manufacturing place (fig. 33).



fig. 33. Raw material accumulation and storage at Khambhat

Drying

Once the nodules are brought to Khambhat, they are dried in the sun to remove the moisture that is trapped within the rock. This is done so that the nodules do not break or develops fissures during heating. This stage is usually carried out for two or three months. Good quality of raw material are sorted and dried for long time and poor quality is kept aside to be sold to other workshops.

Heating

When the nodules are dried sufficiently, it is possible to heat them. The initial heating is done to remove any remaining moisture and make it more homogeneous so that it became easier to flake. A nodule, which is not heated properly, tends to fracture irregularly, whereas properly heated one can be flaked in controlled and efficient manners that conserve the valuable raw material.

The first heating is done in a pot called handla


fig. 34. Heating of raw nodules in handla

(fig. 34). Large scale workshops contain a permanent structure or kiln located separately. The nodules are kept in pots along with saw dust as fuel. This process of heating depends on moisture remaining in the nodules, but generally carried out for 2 to 3 days.

In contrast the small scale entrepreneurs like Anwarbhai, uses kiln made of bricks. This is a temporary structure whose size can be changed according to requirement. Sometime they heat the nodules in handla with rice husk as a fuel in open air, which is a cheaper fuel than saw dust. The heating process is done for a day and there is more breakage due to poor quality of fuel used, nodules not sufficiently dried before firing, the outdoor location and irregular burning of rice husk (Kenoyer, Vidale and Bhan 1994: 281-306). These breakage can be seen in the numerous spalls and broken nodules which get accumulated with the ash of the kilns, scattered on the floor or ground around the kiln area or around the entrance of the kiln. The spalls are good indicators of heating process.

Chipping

The next stage in stone bead production is chipping. It is done by using inverse indirect percussion technique which is unique in south Asia. A pointed iron stake is stuck in ground and the nodule is chipped by resting it against the point of stake and striking it with a hard wood or buffalo horn hammer (fig. 35). By controlling the force of hammer blow, an expert craftsman can easily shape a hard stone.


Fig. 35. Chipping done by using inverse indirect percussion technique

This technique reached at its perfection during Harappan period. Before the introduction of iron, a copper stake could have been used and also before the introduction of copper, a deer's antler stake has probably been used.

There are several chipping phases before a bead rough-out is made from a nodule. The initial chipping is locally called as kakra and chiriya, by which a rough shape of bead is obtained. The next stage or secondary chipping is called as phaphlana and khandvanu, when the final shape of the rough out is made. The iron stake used for this secondary chipping is more pointed than the one used for primary chipping.

In large scale workshops, the primary and secondary chipping is carried out separately and by different craftsmen, so the process is identifiable by observing the debitage of an undisturbed chipping area. On the other hand, the situation as observed in the small scale workshops, the primary and secondary chipping is done by a single man and within the same area by only interchanging the iron

stake like the one which Anwarbhai does at his workshop. Through observation of the scatter of flaking debris resulting from the technique is quite distinctive,if the flaking area were left undisturbed, it would be identifiable archaeologically. Some of the primary and secondary chipping wastes were collected from the workshop to see the difference (fig. 36-37)


fig. 36. Primary chipping waste


fig. 37. Secondary chipping waste, bead rough-out and grounded bead

Sawing

Sawing can be done before or after the initial chipping in order to conserve the valuable raw material. Modern sawing is done with electric powered circular blades. Though the process is much faster, there is a considerable breakage due to the vibration of the blades. Whereas in past, sawing involved a hand drawn saw with copper or iron blade and an abrasive made from emery. This sawing technique has been suggested by archaeologist at Harappan sites for making long carnelian beads (Kenoyer, Vadale and Bhan 1991: 44). It takes 3 to 4 hours of sawing by hand through a small nodule.

Grinding

Before the introduction of electrically powered emery wheels, the bead rough-out was grounded and shaped on a hard sandstone or quartzite. Different shapes of grinding stones must have been used to shape different types of beads, which are an indication of beads grinding in archaeological context. The bead was held in wooden vise which could hold by both the hands, allowing greater pressure to be exerted on the stone. The bead was repeatedly grounded and turned until it was very round in shape (fig. 38). Hand grinding without the use of vise is time consuming and experimental studies conducted on it shows that it would take 4 days to grind a single large bead. If the same size bead is held in a wooden vise the grinding can be completed in approximately 4 to 5 hours. The modern electric powered emery wheel makes it possible to shape the same bead in 4 to 5 minutes and it is much faster.


fig. 38. Electrically powered emery wheel used for grinding

Drilling

After a bead has been grinded smoothly it must be drilled and polished before it becomes a finish product. At Khambhat, beads are first drilled and later polished, or vice versa. The

sequence of stage depends on the availability of artisan. Modern day artisans are also part time farmers, so when it is farming season they do not engage in bead drilling. Thus similar must be the case in past.

Drilling of hard stone such as carnelian and other agates is traditionally done with diamond tipped drills. The use of diamond for drilling beads can be traced as early as the Mauryan period (3rd century BCE), though it may have begun even earlier. But during prehistoric time, diamonds were not used and beads were drilled using a variety of green jasper that is rich in a mineral called Titanium. Neolithic artisan of Baluchistan, Indus valley, Sindh and Gujarat were familiar with the properties of this stone and were able to drill very long beads with tiny stone drills. An experiment using this variety of stone suggests that drilling was the most time consuming process for ancient bead makers. It has been estimated that it would take more than two hours to drill an agate bead which is only 1 cm long (Kenoyer, Vadale and Bhan 1991: 44).

At Khambhat, the drilling of hard stone such as carnelian and other agate are traditionally done with diamond tipped drills. This diamond tipped drills are of two types - one is single type of drill locally known as tekni. It has a single rounded chip diamond at the tip and is used to make a shallow depression for the further drilling. The second type of drill has two tiny rounded diamonds set at the edge of the drill and locally called as sayedi. This drill is used for perforating the beads (fig.39).



fig. 39. Two types of drills tekni and sayedi

As mentioned before,the bead drillers are part time farmers so the author went to meet a very skilled part time driller namely Pratapbhai, at a small town named Nagara. This town is one of the ancient towns where still the tradition of bead drilling is carried out. Pratapbhai showed his techniques for drilling the bead to the author. He explained that how a bead is drilled using two different drills (fig. 40). A bead is drilled in



fig. 40. Pratapbhai drilling a bead by placing the bead in a wooden vise bethi

a wooden vise or bethi and after drilling half way the bead is then turned over and drilled from opposite side. During this process, friction is cooled by a constant dripping of water, supplied by a pot on a tripod which in turn is placed just opposite to the wooden vise. The pot has a hole, through which a wire is set by tying the end with the cotton thread. The water in the pot seeps through the thread and runs down the wire to drip on the top of bead were the drill is turning. This cools down the bead and also acts as lubricant. It also helps to wash out excess agate powder, produced during the drilling process in a bowl beneath the wooden vise. This agate powder is called as vari. It is later recycled and sold to bead polishers to use it in final polishing of beads.

This technique of drilling from both the sides is used for all beads except the small spherical ones. It takes a great deal of skill to make the opposing drill holes meet perfectly. Today there are a few craftsmen who can to do this

consistently and Pratapbhai is one of them. Small beads that are drilled from both the sides are characterised by a conical flake scar that is produced when the pressure of the drill pipes through the end of the bead. This technique is ancient which has been archaeologically proved as a good number of small beads were found from the early historic levels from the site of Nagara.

Tabular Drilling

This type of drilling has also been used since ancient time to remove large portion of stone efficiently. Until the introduction of electric powered drills, tabular drilling was done with copper/ bronze or iron drills and emery was used as abrasive.

Polishing

Polishing of hard agate is a lengthy process that first requires fine grinding with different grades of abrasives. These abrasives are usually emery or corundum powder that is mixed with lac and shaped into a wheel. Before the introduction of electricity, the abrasive wheels were on a lathe with a bow held in one hand while the bead is held against the wheel in the other hand. The final polishing is done on the wooden wheel and the polishing powder or vari is applied on the wooden wheel (fig. 41). This method is time consuming and it takes 3 or 4 hours to polish a single bead.

In ancient times, artisans had developed a technique using which many beads were polished at a time. In this technique, beads were placed in a leather bag or mashak with the abrasive powder. Initially the leather bag was rolled back and forth by hands for 6 days, until the beads attained a smooth semi-polished surface. Later, the beads were removed and carefully washed to remove all traces of the



fig. 41. Polishing of bead on a wooden wheel by using *vari*

abrasive. For the final polishing, they were placed in the bag once again with a small amount of water and vari powder and the bag was rolled by two persons using a rope for 9 more days. At the end of such a long period of 15 days they achieve a low lustrous polish and that is the characteristic of the ancient bag polished beads. Although this process has not been in practice in Khambhat for over 50 years but it was possible to recreate the technique experimentally.

Final Heating

After drilling and polishing, these beads are heated numerous times to achieve a deep red-orange colour which makes it pure carnelian. This heating process is carefully monitored by specialised craftsmen who tend the kilns and ensure that the beads are not heated over 300-350 degree Celsius.

Beads are first sorted according to colours in order to avoid overheating. Then these beads are placed in small earthenware and covered with ash to protect them from thermal shock. These pots are then placed in the kiln and covered with fuel. Saw dust is used for low heat

and cow-dung along with charcoal is used for high heat. Some beads require 7 to 10 firings before they achieve the deep red colour, which is known as the highest quality of carnelian.

Traditional Markets

At present, both large and small scale merchants trade these carnelian beads in markets. Some trade activities are also carried out by travelling pilgrims, sadhus and fakirs. Archaeological excavations and references in the Vedic and epic literatures gives evidence of the use of agate to make beads, amulets, medicines and ritual objects.

Agate ornaments (fig. 42) and special objects made in Khambhat and other production centers in Gujarat have been traded to all regions of the world like Nepal, Tibet, China, Afghanistan, Iran, and the Arab countries, Africa, Europe and America.



fig. 42. Finished bead necklace

During the field work at Khambhat, author studied the techniques of bead-making at a workshop (small scale merchant) owned by Anwarbhai Sheikh, son of late Inayat Hussain. The controlled workshop could not be studied as the owner has migrated to America.

Discussions

The ethnoarchaeological study of bead manufacturing at Khambhat has provided an idea of different types of workshops that produce carnelian beads with varying degrees of control. The study has also showed a clear insight on the working of past societies. By correlating the archaeological pattern of manufacturing waste and finished objects with other features such as architecture and the settlement layout it is possible to identify the levels of organisation and control of production. Thus it has become a necessity now to carry out such ethnoarchaeological studies in order to record a wide set of data on the traditional specialised industry before it is completely transformed by constant technological changes.

References

Acharya, M.L., Vora, U.D. and Trivedi, R.K. (1964) ***Agate Industry of Cambay***, Manager of Publications, Govt. of India, Delhi.

Gadekar, Charusmita (2006) An ***Ethnoarchaeological Fieldwork Carried Out in Khambhat,*** Term Paper Submitted to the Department of Archaeology and Ancient History, MSU Baroda, Baroda.

Janaki, V.A. (1980) The Commerce of Cambay from the Earliest Period to the Nineteenth Century, ***Geography Series,*** 10, MSU Baroda, Baroda.

Kenoyer, J.M., Vidale, M. and Bhan, K.K. (1991) Contemporary Stone Bead Making in Khambhat, India: Patterns of Craft Specialization and Organization of Production as Reflected in the Archaeological Record, ***World Archaeology***, 23 (1), MSU Baroda, Baroda.

Kenoyer, J.M., Vidale, M. and Bhan, K.K. (1994) Carnelian Bead Production in Khambhat, India: An Ethnoarchaeological Study, In: Bridget Allchin (ed.) ***Living Traditions: Studies in the Ethnoarchaeology of South Asia,*** Oxford and IBH publishing Co. Pvt. Ltd.

Mehta, R.N. and Shah, D.R. (1968) ***Excavations at Nagara,*** MSU Baroda, Baroda.

Rao, S.R. (1973) ***Lothal and the Indus Civilization***, Asia Publication House, Bombay.

Tringham, R. (1978) ***Experimentation, Ethnoarchaeology, and Leap Frog in Archaeology Methodology,*** University of Mexico, Mexico.

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Ontario Place:

A Place to Stand? A Place to Grow? A Biographical Approach to Landscape Research Managing Change in Modern Cultural Landscapes

Desiree Valadares

Introduction

Why study history, if our goal is to design the future? This is perhaps best answered by philosopher George Santayana who said: ***Those who cannot remember the past are condemned to repeat it.***

The research goal of this study was to conduct a deep analysis of Ontario Place, in Toronto (fig. 43) to better understand its historical evolution as a product of myriad socio-cultural, political and economic

fig. 43. Ontario Place, Toronto: Context Map (source: Google Earth)

factors (fig. 44). Over the years, this neglected modernist landscape, like many other worldwide cultural landscapes and buildings designed in the Modern Era, has received surprisingly little scholarly attention. After years of neglect and lack of conservation efforts, Ontario Place was recently added to the Heritage Canada Foundation's 2012 Top Ten Endangered List. The site is currently the focus of a major controversial revitalisation agenda led by the Province of Ontario that aims to privatise a large portion of the site.



fig. 44. Ontario Place, Toronto: Digitally Rendered by Author

Ontario Place: A Place to Stand, A Place to Grow

Ontario Place is a landmark destination that is historically significant as the first instance in Toronto's history in which the tremendous potential of the waterfront for renewal, recreation and tourism was to be based on a major lake fill project. Previously, lake filling was used to create vast tracts of new land for industrial purposes that obliterated the amphibious landscape of the city's original shoreline.

Located along Toronto's Central Waterfront (fig. 45), Ontario Place was an artificially created site in the late 1960s and highly regarded as a feat of architectural engineering. This landscape was designed by two of Canada's most notable architects - Eberhard Zeidler and the late landscape architect Michael Hough.



fig. 45. Ontario Place, Toronto: 1961 - 2013, City of Toronto Archives

Over the years, the site has received numerous awards and most notably has been honored by the Ontario Association of Architects 5th Year Award in recognition of the site's "historical and lasting architectural significance." Though designed as urban parkland and intended to reclaim the shoreline for the people, Ontario Place has evolved in a manner different from its original design intent (fig. 46-47).

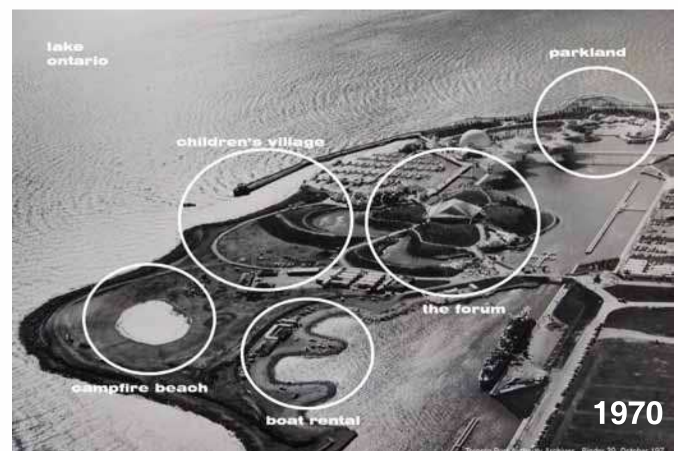


fig. 46. Ontario Place, Toronto Port Authority Archives

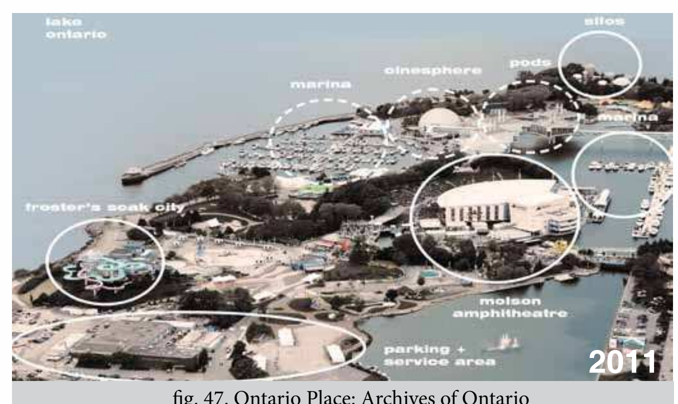


fig. 47. Ontario Place: Archives of Ontario

The Government of Ontario's mandated closure of this landmark site in February 2012 which generated media attention and public discussion. With a major controversial revitalisation agenda underway that threatens the historical and cultural integrity of the landscape, the future of Ontario Place is bleak. This thirty-nine hectare public space may soon be privatised and stripped of its distinct architecturally significant features and original design intent as publicly accessible waterfront land. For this reason, the present study relied on historically grounded research to re-construct and convey an important, yet untold story of a forgotten cultural landscape to aid in future conservation efforts. The role of landscape biography as research method was tested as a viable strategy for public education, protection, management and development of this public asset and modernist landmark site.

Research Methodology

Landscape biography, an empirical research strategy, was used to capture the transformational character of Ontario Place through archival research and oral histories over five phases of development. This idea of studying the history and transformation of landscapes with the aid of a biography originates from human geography, specifically the humanistic school. Samuels (1979) suggested that landscape biography could focus attention on humans as actors and an important "landscape-shaping force". Currently, landscape biography is heavily utilised by Dutch landscape researchers to study the long-term effects on a landscape and effectively integrate cultural and ecological values to inform future spatial planning decisions.

In order to understand the evolution of Ontario Place and to suggest compatible future transformations, this study was conducted over nine months (August 2012 to April 2013) using landscape biography as research strategy. The study had four main objectives:

1. To address challenges and opportunities involved in revitalising Toronto's post-industrial waterfront, by conducting a literature review,

2. To develop a narrative history and hypothesis of how Ontario Place evolved through archival sources and oral histories,

3. To formulate a theory to explain the genesis and evolution of the site, and

4. To compile a framework that highlights factors that should be considered in future development and revitalisation of Ontario Place.

Due to the lack of published site-specific material on Ontario Place, data was collected primarily through archival research and through semi-structured interviews over a nine month period. The landscape was studied as it evolved in five life stages, or phases, that roughly corresponded to a decade each, from its inception, in 1968 onward. Plans, construction drawings, concept sketches, policy, newspaper articles, strategies and consultant reports, annual reports, photographs stored in five public archives (in Toronto and Guelph, Ontario) were reviewed. These historical records were verified against semi-structured 'elite' interviews or oral histories with fourteen interdisciplinary key players that corresponded to each phase. A biographical narrative of this site was developed and a hypothesis of how the site evolved was proposed. Periods of stasis and punctuated moments in its history, that were contingent on outside forces, be it political, economic, social, cultural shifts, were identified in this iterative process.

The dynamics of landscape change, once recorded in the landscape biography, were analysed and visualised by adopting a concept from evolutionary biology: punctuated equilibrium (fig. 48). By taking a cue from

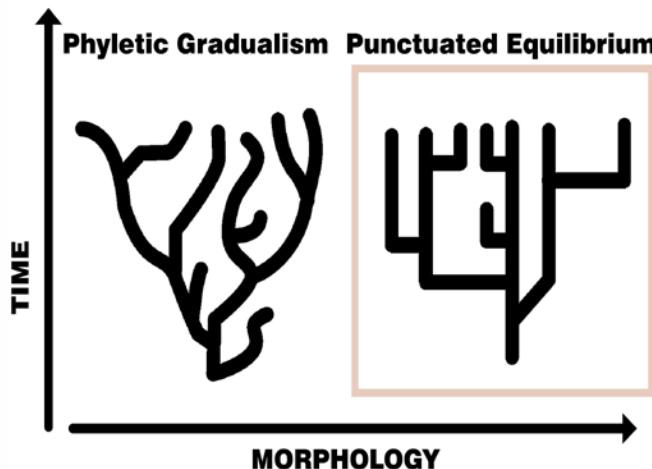


fig. 48. Punctuated equilibrium

evolutionary biology and the pioneering work of paleontologists Stephen Gould and Niles Eldredge (1970), the concept of punctuated equilibrium was used to map rapid, episodic events that triggered morphological change in the landscape (fig. 49). These punctuated moments, followed by longer periods of equilibrium were isolated to understand the factors in the surrounding environment that triggered these events in the

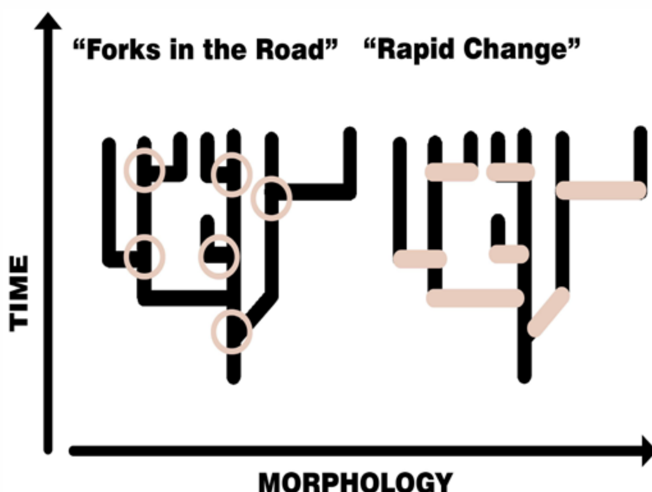


fig. 49. Punctuated equilibrium

landscape's life cycle (fig. 50).

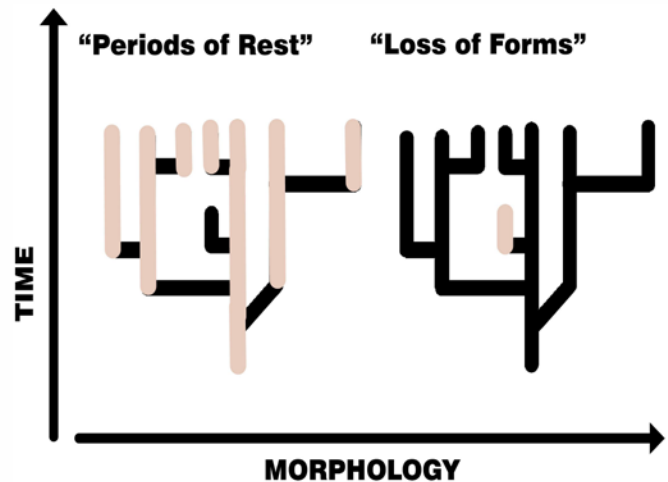


fig. 50. Punctuated equilibrium

Life Cycle Analysis

Punctuated equilibrium was a valuable metaphor in this study as it provided a means to map Ontario Place's transformational history, or landscape biography, which did not have any implied evolutionary track or specific linear coherence (fig. 51). The evolution of this landscape simply responded to existing conditions at the time and by tracing this landscape's evolution; its historical trajectory

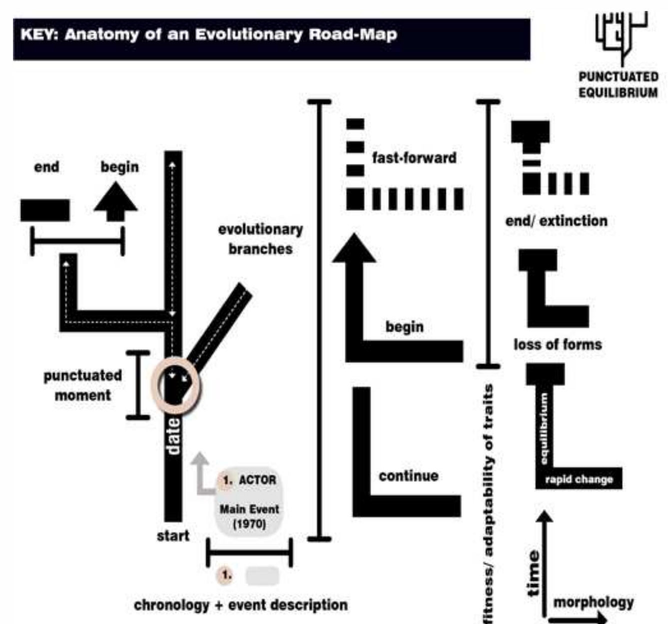


fig. 51. Anatomy of an evolutionary road map

and its existing context, it is evident that the site had a long history of multiple uses and a record re-inventing itself. From the outset, employing a product lifecycle perspective (a "cradle to grave" approach) revealed that the majority of impacts or punctuated moments occurred in life-cycle phases outside of direct control. The character of landscape development and change was influenced by historical, geographical and social circumstances and conditions, as well as by collective and individual activity. The historical imprint of Ontario Place is the culmination of years of intense relations between various factors, making it impossible to study one without the other.

New paths of landscape development or new landscape trajectories were observed in compiling the landscape biography of Ontario Place, with the aid of a punctuated equilibrium metaphor. This evolutionary biological model, when applied to the study of landscape history, revealed the often elusive interplay of historically contingent events which contributed to Ontario Place's transformational history contributing to a richer and fuller understanding of this landscape's evolution. This metaphor also helped to clarify the stop/ start nature of the process of landscape transformation and the unpredictableness of the end point. In the context of landscape formation, five distinct phases were distinguished and interventions in the landscape during these phases were visualised through a series of evolutionary road-maps.

The idea of building a utopian park far removed from the city's downtown core without an adequate transportation connection probably doomed Ontario Place as a socially integrated park. Over time, the site had been reduced to a volumetric typology of underutilised forms and programmed spaces whose functions were strictly regulated and their uses predetermined. The un-programmed "in-between" spaces slowly diminished and with it the modernist egalitarian values and social aims on which the original master plan for Ontario Place was based. The way in which Ontario Place evolved indicates an imbalance between the distinctly defined sectors of the original plan and the subsequent piecemeal transformations on this waterfront site.

During its very origins (1968-1971), Ontario Place had strong associations with residential development as proposals like the 1968 Bold Concept and 1970 Harbour City Report were put forth (fig. 52). Though mandated as a recreation and exhibition grounds by the Ontario Place Corporation Act (1991), this

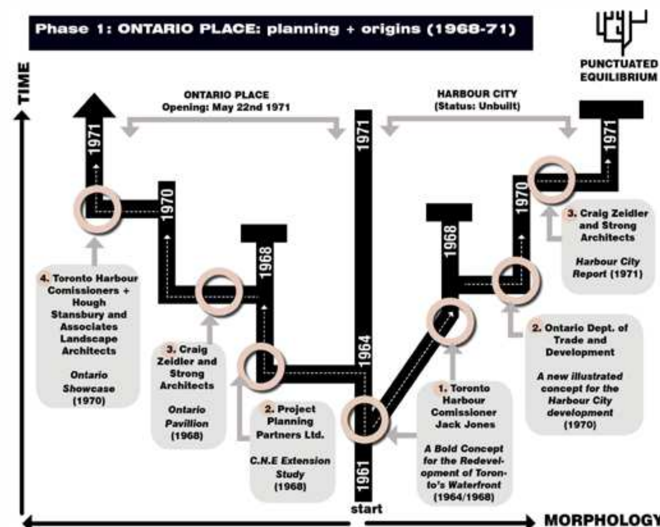


fig. 52 Ontario Place: Planning and Origins, 1968-1971

landscape functioned as passive parkland in its early years (1971-1980) (fig. 53) and an

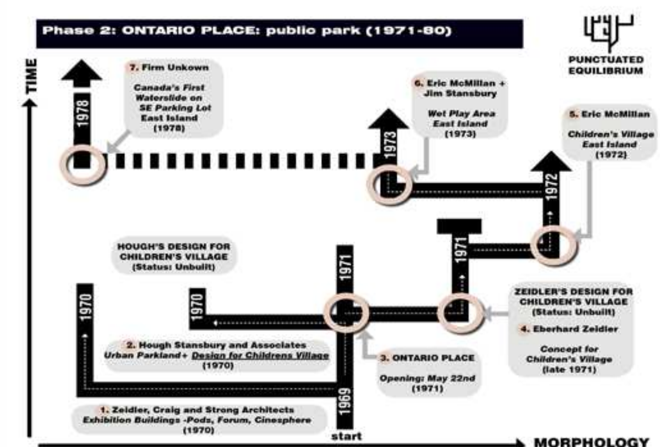


fig. 53. Ontario Place: Public Park, 1971-1980

exhibition venue during subsequent years of transformation and addition (1980-1990) (fig. 54) of elements on site. In the 1990s, the whole idea of Ontario Place shifted dramatically

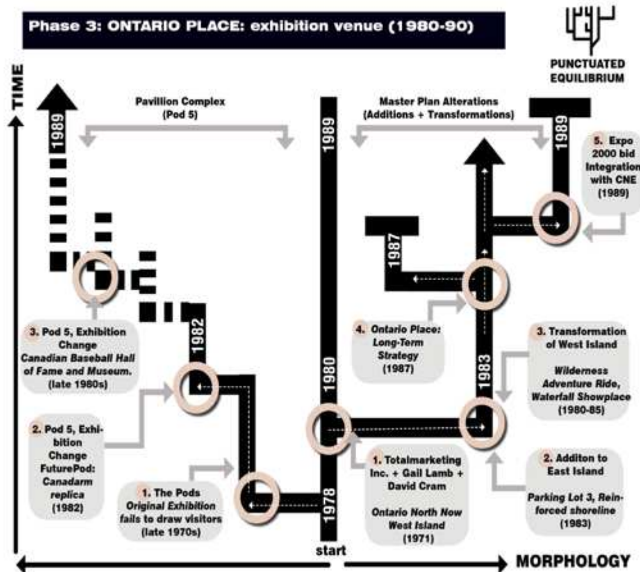


fig. 54. Ontario Place: Exhibition Venue, 1981-1990

as thematic displays and attractions morphed this landscape into an amusement park (1990-2000) (fig. 55). The following decade, (2000-2012) saw focused efforts to brand this site

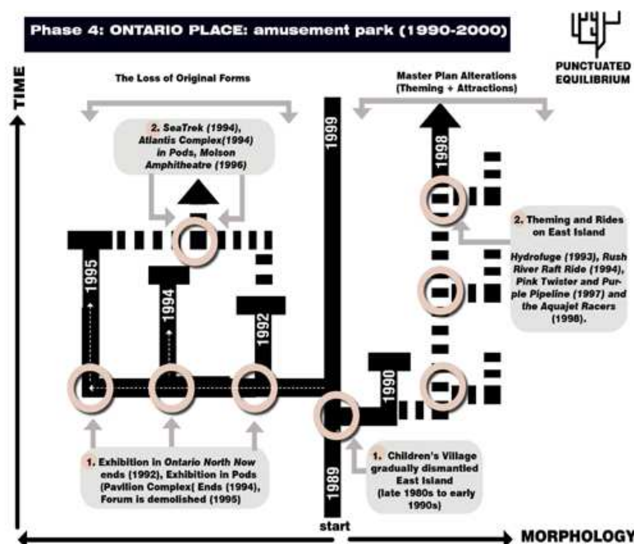


fig. 55. Ontario Place: Amusement Park, 1991-2000

as an ecologically and culturally significant waterfront tourist destination (fig. 56).

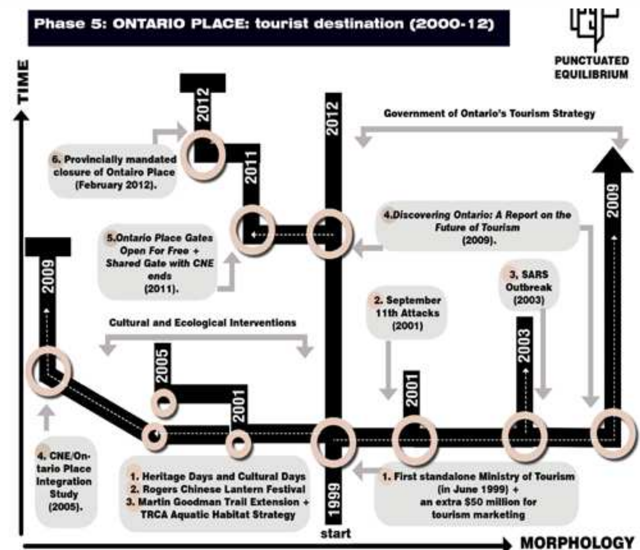


fig. 56. Ontario Place: Tourist Destination, 2001-2011

The vestiges of this historically significant cultural landscape are characterised by the loss of forms and the dilution of the site's original character as urban parkland. Punctuated moments in the site's historical trajectory were amplified through dramatic and often sweeping changes in this landscape that involved a restructuring of the built environment and loss of critical forms. This in turn, triggered larger issues. The gravitational pull of Ontario Place as a waterfront destination slowly diminished for residents and visitors alike. Without a clear direction, Ontario Place risks repeating the mistakes of its past and drifting further into mediocrity (fig. 57).



fig. 57. Ontario Place: Life Cycle analysis

Could this metaphor help to predict future planning? A resounding yes!, since the 'existing conditions' that Ontario Place experienced for four decades have some distinct similarities. If designers involved in the revitalisation process for Ontario Place, study and analyse its genius loci and its historical evolution in order to comprehensively understand how the site functioned socially, ecologically, economically and politically over time then perhaps there is a greater likelihood of creating a design that respects and enhances all of these relationships. Furthermore, these designs should reflect flexibility and adaptability to accommodate future evolution of this landscape as conditions change in often unpredictable ways. The revitalisation of this landmark site should therefore reinforce the intangible link between history, cultural values, and future spatial transformation.

Recommendations

Ontario Place is currently at a cross-road, a punctuated moment, and to move forward, this site requires a clear vision and a clearer understanding of its history and the forces that have shaped it. The following is a broad framework that highlights four factors that should be considered in future development and revitalisation of Ontario Place.

1. Conduct a Cultural Heritage Landscape Assessment, a Heritage Impact Assessment and Cultural Management Plan for Ontario Place to Identify and Define Key Areas of Character

It is troubling that the provincial mandate for the revitalisation of Ontario Place failed to include a heritage impact assessment and a cultural management plan. These documents would explicitly identify and define key areas of designed landscape character, significant built heritage and significant cultural heritage landscape components of this crown-owned land to establish parameters for its revitalisation. Despite its undesignated status, the province has a responsibility to conserve significant elements in this landscape and should use a certain protocol toward conservation. According to heritage architect Michael McClelland from E.R.A Architects Inc., there needs to be some kind of investment and respect for the works of architect Eberhard Zeidler and landscape architect Michael Hough. "Conservation needs to be a part of the broader conversation" (Interview with McClelland, February 2013).

2. Recognise Ontario Place as a Continuing Evolving Cultural Heritage Landscape

Though currently undesignated, Ontario Place fulfills the criteria in Regulation 9/06 Criteria for Determining Cultural Heritage Value or Interest in the Ontario Heritage Act. As specified in the Provincial Policy Statement, 2005:

S. 2.5.1 Significant built heritage resources and cultural heritage landscapes will be conserved.

Ontario Place is a significant cultural heritage landscape that can be further classified as a one that has "evolved" to "reflect the physical, biological, and cultural character of our everyday lives, [and] function plays a significant role" (Birnbaum 1994: 2). The site is a continuing evolving landscape which "exhibits significant material evidence of its evolution" (UNESCO World Heritage Committee; Parks Canada, 1994; and Ontario Heritage Foundation, 2001; Ontario Heritage Toolkit) and should be treated as a whole rather than the sum of its parts. This poses a challenge in the conservation process but could be a rather interesting undertaking that could advance cultural heritage policy for the study and protection of modern landscapes, which has been largely neglected.

3. Develop an Education and an Interpretation Strategy: "Making Post-War Landscapes Visible"

In Ontario, cultural landscape policy for modern (post-war) landscapes is outlined in both, the Provincial Policy Statement and the Ontario Heritage Act. But according to McClelland (2004), there is a gap in this legislation regarding the protection of provincially owned heritage properties which results in the exclusion of protection of modern cultural resources on site (McClelland 2004: 3). Many modern, provincially owned post-war landscapes, like Ontario Place, are undesignated (with the exception of Sasaki's Queen Park Complex in 2000). Furthermore, little accessible published information exists for these modern landscapes and Ontario Place, in particular, has received hardly any scholarly attention. The opportunity to disseminate information on the historical evolution of the site to a broad public base could encourage people to -

a) understand the site's historical significance;

b) be interested in architectural history and local history;

c) appreciate and respect the site; and

d) make efforts to protect or preserve portions of the site, adopting it as a valuable identity source in their community.

4. Establish a Long-Term Master-Plan that Ensures Public Space and Access along Toronto's Waterfront and Meaningful Co-operative (not Competitive) Partnerships

Based on Toronto's "sad history of waterfront errors," the provision for an accessible lakefront is vital. Ontario Place was intended to reclaim the shoreline for the people and should remain a public asset. The sale of publicly held land in Toronto has led to an "undesirable urban landscape" (Desfor and Laidley 2011) and the revitalisation of Ontario Place should be put into "competent hands" like Waterfront Toronto instead of the provincial agency, Infrastructure Ontario known for working with the private sector (Hume's remarks at Rethinking Ontario Place Town Hall, 2013; Opinion Piece, Toronto Star 2012). As Ken Greenberg warned in his article, "Will Toronto's Waterfront Become a Concrete Wasteland?" leaving "the making of context" to the private sector has many obvious consequences (Greenberg 1969: 195-218).

Secondly, the revitalisation of this landmark site should not move at "lightning speed", as suggested by the Minister of Culture, Tourism and Sport. This is a major irreversible decision that requires broad consultation and public discussion. It requires a shared vision, an integrated strategy, strong leadership, ongoing investment and participation on all levels.

If the adjacent Exhibition Place and Ontario Place are to be jointly developed, the subsequent long-term master plan for both sites should honor and enhance the historical integrity of the sites. The future of both sites should not be compromised by repeating mistakes of the past. A waterfront casino in the proposed integrated Exhibition Place - Ontario Place location is not an appropriate solution. Casinos, as described by Waterfront Toronto CEO John Campbell in 2012, are "land-consumptive, low-density, and inwardly-oriented." This is in direct conflict with Ontario Place's origin intent, its historical evolutionary trajectory and it will undermine the value and character of both sites as public space for all people.

Conclusions

Compiling the landscape biography of Ontario Place brought into question the role of public history and the larger fundamental issue that landscape architectural history, particularly modern landscape history, is often not told, valued or made accessible to a broader audience. Despite the lack of a formal heritage designation, Ontario Place features the contributions of several notable Canadian architects, landscape architects and designers. This comprehensive historical account of Ontario Place provided a narrative of how the site responded and adapted to social, ecological, economical and political changes in its 40 year history. It is anticipated that this document may be of use during potential heritage impact assessments or cultural heritage reports that may be initiated during the early revitalisation stages.

Finally, the study warranted a further investigation of cultural landscape policy specifically addressing the challenges of conserving vulnerable landscapes of the Modern Era (1930-70) by developing stronger legislation and financial incentives to identify, study, conserve and promote this aspect of the built environment as viable cultural heritage.

References

Birnbaum, C. (1994) Protecting Cultural Landscapes: Planning, Treatment and Management of Historic Landscapes, ***Preservation Briefs Number 36,*** U.S. Department of the Interior, National Park Service, Washington D.C.

Desfor, Gene and Laidley, Jennifer (2011) ***Reshaping Toronto's Waterfront,*** University of Toronto Press Incorporated.

Eidelman, Gabriel (2013) ***Landlocked: Politics, Property, and the Toronto Waterfront, 1960-2000***, Unpublished PhD dissertation, Department of Political Science, University of Toronto.

ERA Architects Inc. and Jeff Evenson (2001) ***Canada's Urban Waterfront, Waterfront Culture and Heritage Infrastructure Plan***, part 1, Central Waterfront - Prepared for the Culture Division, Economic Development, Culture and Tourism Department and the City of Toronto,http://www.toronto.ca/culture/brochures/brochure_canadasurbanwaterfront.pdf [Accessed: February 2013]

Gemmil, Arlene (1981) ***Ontario Place: The Origins and Planning of an Urban Waterfront Park,*** Discussion Paper No. 25, Department of Geography, York University, Toronto.

Greenberg, Ken (1996) Toronto: The Urban Waterfront as a Terrain of Availability, In: P. Malone (ed.) ***City, Capital and Water***, Routledge, London.

McClelland, Michael (2004) Designating Modern Cultural Landscapes in Canada, In: ***Preserving Modern Landscape Architecture II: Making Postwar Landscapes Visible,*** Spacemaker Press.

Ontario Heritage Toolkit, ***Heritage Conservation Districts - A Guide to District Designation Under the Ontario Heritage Act,*** http://www.mtc.gov.on.ca/en/publications/HCD_English.pdf

UNESCO, World Heritage Centre, ***Cultural Landscapes,*** United Nations Educational, Scientific and Cultural Organisation, http://whc.unesco.org/en/culturallandscape/ [Accessed: March 2013]

(1994) ***An Approach to Aboriginal Cultural Landscapes: Cultural Landscapes - Canadian Approach - Has Canada entered into this growing dialogue on cultural landscapes as heritage resources?*** http://

www.pc.gc.ca/docs/r/pca-acl/sec2/sec2c_e.asp [Accessed: March 2013]

(2001) ***Characteristics of Cultural Landscapes,*** Ontario Heritage Foundation, Government of Ontario, Toronto.

(2005) Provincial Policy Statement, ***The Planning Act. 2.6 Cultural Heritage and Archaeology,*** http://www.mah.gov.on.ca/Page1485.aspx#2.6 [Accessed: February 2013].

(2006) Policy: Regulation 9/06 Criteria for Determining Cultural Heritage Value or Interest, ***Ontario Heritage Act,*** http://www.e-laws.gov.on.ca/html/regs/english/elaws_regs_060009_e.html [Accessed: February 2013]

(2012) Anonymous Opinion Piece, Put Ontario Place redevelopment into competent hands: The Redevelopment vision for Ontario Place is a good one but the Province's approach does not inspire confidence, ***Toronto Star***, http://www.thestar.com/opinion/editorials/2012/08/17/put_ontario_place_redevelopment_into_competent_hands.html [Accessed: February 2013]

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Miss Desirée Valadares spent the first twelve years of her life in the dense urban enclave that is Mumbai, India. Living among remnants of colonial and indigenous empires instilled in her an appreciation for cultural history, architectural heritage and the importance of freedom of creative and artistic expression. Trained in the arts and the sciences (B.Arts Sc.), at McMaster University, Desirée combined her interests in both disciplines with a graduate degree in landscape architecture (MLA) from the University of Guelph. Whilst a student, Desirée called several cities home including Hamilton, Florence, Guelph, Edinburgh and Rotterdam for varying periods of time. Currently, she is a practicing intern landscape architect in Toronto at Quinn Design Associates and is working toward obtaining her architectural licence.



Temples at Badami

Mukta Latkar-Talwalkar

The erstwhile capital of the most powerful early Chalukyan Empire of Southern India, Vatapi, as Badami was known then, is a wonderland of ancient Indian art and architecture. Pulakesin I, the early Chalukyan monarch, established the first early Chalukyan capital of the Empire here in the mid 4th century CE which went on to rule almost the entire south India for the next 200 years. The evolution of Hindu rock-cut architecture including caves, structural temples and exuberant stone sculptures, beautifully morphed with the mesmerising sandstone rock formation, together put up a cultural show par excellence.



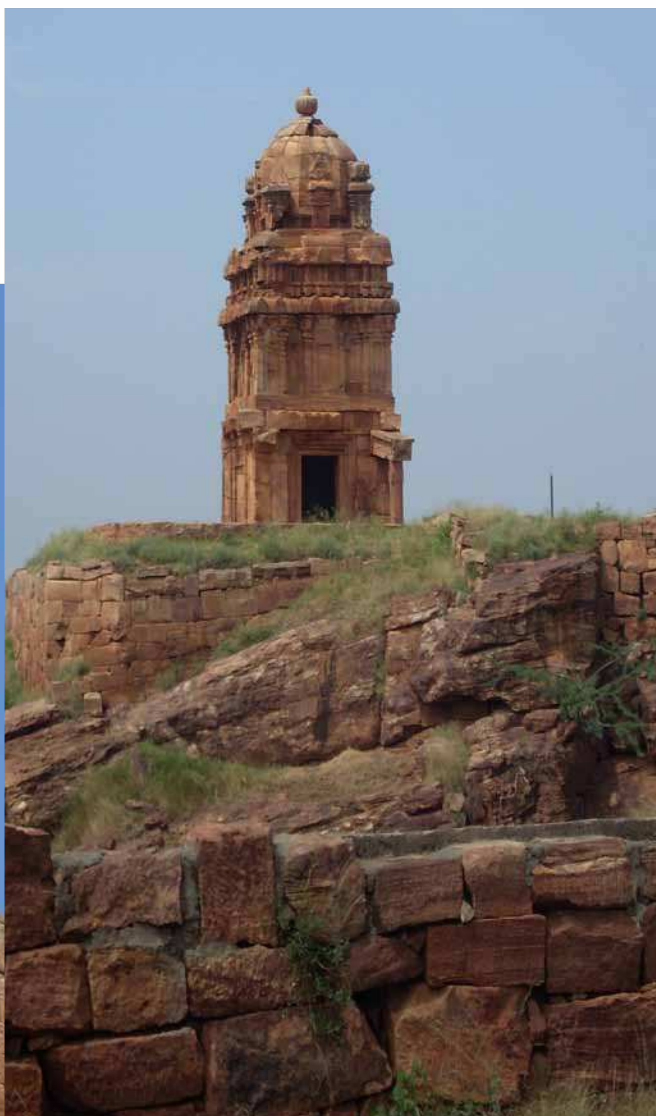


fig. 58-59. Lower Shivalaya: This lone standing sanctuary displays an interesting stage of the development of the sikhara (tower) of the Dravidian type. The oval pedestal inside the sanctum is supposed to have supported the famous Vatapi Ganapati once.



fig. 60-61. Upper Shivalaya: This partially demolished rudimentary Dravidian temple is one of the earliest structural monuments in Badami. Many architectural features and sculptural panels on the external walls exhibit the great quality of early Chalukyan art.

fig. 62. Bhoothnath Temple: This 8th century prominent Dravidian style temple along with later period smaller shrines around it is beautifully located on the back drop of a sandstone cliff and on the bank of the great Agastya Tirth lake.



fig. 63. North Bhootnath Group of Temples: These temples belonging to the 11th-12th century CE have peculiar layered pyramidal towers, closed mandapas, plain outer walls and pillared half open porches with balcony seating.



fig. 64. Malegitti Shivalaya: This finest and most completely preserved early Chalukyan temple in Badami is beautifully decorated from the outside with impressively evolved Chalukyan sculptures displaying Vishnu, Shiva and the Dwarapalas among others



fig. 65. Yellama Temple: Originally dedicated to Lord Vishnu, this late Chalukyan (12th century CE) temple has an experimental combination of elements of both the Nagara and Dravidian architectural styles interestingly displayed in its sikhara along with the peculiar inner lathe-turned pillars of the mandapa.

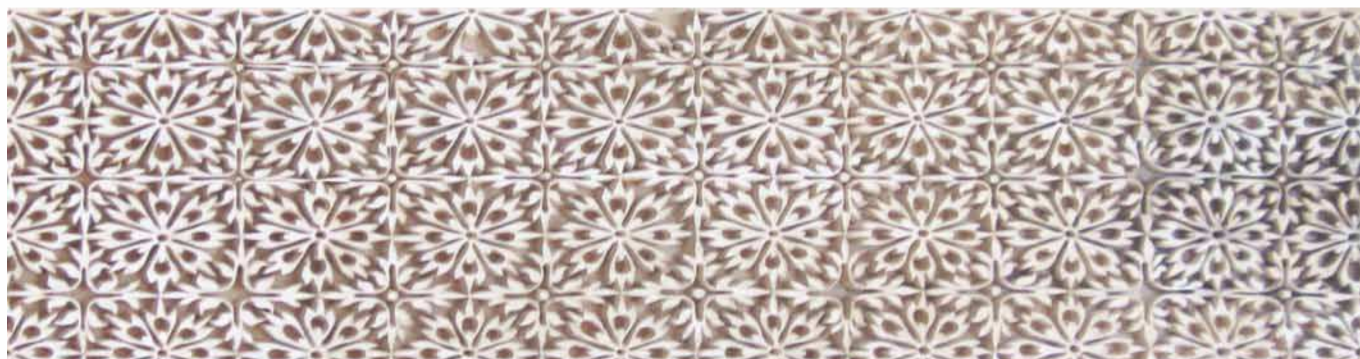
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International Conference on Interpretation of Built Heritage

Organisers: Punjab Heritage and Tourism Promotion Board

Date(s): 30th September, 2013

Venue: Chandigarh

E-mail: kawalnain@gmail.com

47th Annual Conference of Indian Archaeological Society

Organisers: Indian Archaeological Society
Date(s): 14th-16th December, 2013
Venue: Centre of Advanced Study Department of AIHC and Archaeology, Banaras Hindu University, Varanasi
E-mail: bhuarchaeologyconference2013@gmail.com

International Conference of Society of South Asian Archaeology

Organisers: Directorate of Culture and Archaeology, Government of Chhattisgarh; the Department of Archaeology, Pandit Ravi Shankar Shukla University, Raipur; and the Society of South Asian Archaeology

Date(s): 18th-22nd Febuary, 2014

Venue: Directorate of Culture and Archaeology, Government of Chattisgarh, Raipur

E-mail: sosaaindia@gmail.com

Asia Pacific Conference on Underwater Cultural Heritage

Organisers: National Marine Sanctuary Foundation and University of Hawaii
Date(s): 12th-16th May, 2014
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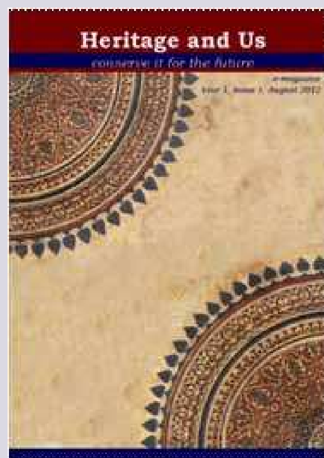
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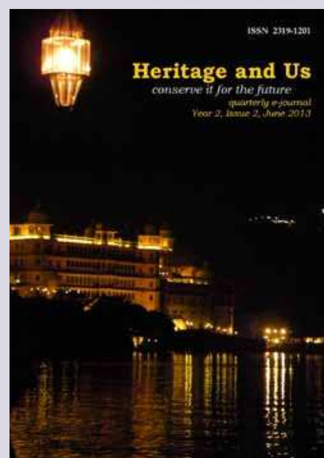
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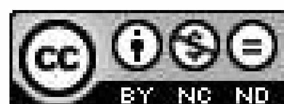
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